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FORTY-THIRD

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

EIGHTH ANNUAL REPORT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

1895.

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STATE BOARD OF AGRICULTURE, 1896.

Members ex Officio.

His Excellency FREDERIC T. GREENHALGE.
His Honor ROGER WOLCOTT.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
WM R. SESSIONS, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term expires
SPRAGUE S. STETSON of Lakeville,	1897
DWIGHT A. HORTON of Northampton,	1898
JAMES S. GRINNELL of Greenfield,	1899

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	F. W. SARGENT of Amesbury,	1897
Barnstable County,	JOHN BURSLEY of West Barnstable,	1898
Berkshire,	SAMUEL M. RAYMOND of Hinsdale,	1897
Blackstone Valley,	HENRY A. COOK of Northbridge (P. O. Whitinsville),	1897
Bristol County,	N. W. SHAW of North Raynham,	1899
Deerfield Valley,	F. H. SMITH of Ashfield,	1899
Eastern Hampden,	W. M. TUCKER of Monson,	1897
Essex,	F. H. APPLETON of Peabody (P. O. Lynnfield),	1899
Franklin County,	GEO. E. TAYLOR of Shelburne (P. O. Greenfield),	1898
Hampden,	F. E. CLARK of Wilbraham,	1897
Hampshire,	WM. P. BROOKS of Amherst,	1898
Hampshire, Franklin and Hampden,	C. B. LYMAN of Southampton,	1897
Highland,	SAMUEL M. RAYMOND of Hinsdale,	1899
Hillside,	C. K. BREWSTER of Worthington,	1899
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1897
Hoosac Valley,	WM. H. GOVE of North Adams (P. O. Blackinton),	1897
Housatonic,	F. A. PALMER of Stockbridge,	1897
Marshfield (Agr'l and Hort'l),	JOHN H. BOURNE of Marshfield,	1897
Martha's Vineyard,	H. G. NORTON of West Tisbury,	1898
Massachusetts Horticultural,	E. W. WOOD of West Newton,	1897
Massachusetts Society for Promoting Agriculture,	FRANCIS SHAW of Wayland,	1897
Middlesex North,	A. C. VARNUM of Lowell,	1898
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1899
Nantucket,	J. S. APPLETON, Jr., of Nantucket,	1897
Oxford,	W. M. WELLINGTON of Oxford,	1898
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1899
Spencer (Far's and Mech's Assoc'n),	JOHN G. AVERY of Spencer,	1898
Union (Agr'l and Hort'l),	CURTIS M. BLAIR of Blandford,	1898
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1897
Worcester,	J. LEWIS ELLSWORTH of Worcester,	1899
Worcester East,	W. A. KILBOURN of South Lancaster,	1897
Worcester North,	GEORGE CRUICKSHANKS of Fitchburg,	1899
Worcester North-west (Agr'l and Mech'l),	A. D. RAYMOND of Royalston,	1898
Worcester South,	G. L. CLEMENCE of Southbridge,	1898
Worcester County West,	E. A. HARWOOD of North Brookfield,	1899

THE FORTY-THIRD ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The season of 1895 was a peculiar one for Massachusetts farmers. The markets were well supplied with all necessaries and luxuries, at prices within the reach of all classes of consumers. The yield of nearly all crops was abundant, and where, as in the case of the apple crop, the yield was small, the supply from other parts of our own country and from Canada prevented the rise of prices. According to the reports of our crop correspondents, the season, notwithstanding the abundant crops, proved to be anything but a profitable one. Many correspondents November 1 said they could tell what crops had turned out to be most profitable, and others said there had been no profit in anything. This condition was due chiefly to the low prices which have prevailed and the slow sale of produce. Prices have been almost universally reported as lower than for some years. Only seven of the one hundred and four correspondents making returns November 1 spoke of prices as average and only two as above average; while several spoke of them as lower than ever before in their recollection. The cause usually assigned for these low prices was the unprecedented yield of many crops raised for market all over the country. Some correspondents spoke of drought as shortening crops and thus reducing profits, and others alluded to the scarcity of help as increasing expenses and so cutting down profits. Tobacco has proved to have been a very paying crop this season, while the profits from other special crops, as potatoes and onions, have been very small indeed.

MASSACHUSETTS WEATHER, 1895.

[Compiled from data furnished by the New England Weather Service.]

January gave slightly warmer weather than normal in the eastern part of the State, and slightly colder in central and western counties. There was no general thaw and no extremely cold weather. The precipitation was above the normal in the southern part, but less than the usual amount came in the centre and north. About the normal amount of snow fell during the month, and with the steady temperature most of it remained on the ground, giving a good protection to all roots and shrubs. The only storm of marked severity was that of the 26th–27th, when some damage was done along the coast by the wind, and travel was hindered in the interior by drifting snow.

February was cold and dry. The temperature averaged from 2° to 7° a day below the normal throughout the greater part of the State. The temperature rose several degrees above freezing in south-eastern Massachusetts on the early morning of the 8th, then fell rapidly and to a low point under the influence of north-west winds which prevailed. At Provincetown the daily range on the 8th was the greatest ever recorded there in fourteen years of observation, while the minimum on the 6th was the lowest ever registered there in that time. The precipitation was generally in the form of snow, except in the extreme south-east, and most of it came in the storm of the 7th–8th. This storm was extremely severe, and great damage was done along the coast by the high tide and terrific winds. The ground was mostly well covered with snow throughout the month. There was some injury to peaches by the cold spell, and the very high wind drove the cold into many cellars that were considered frost-proof.

The weather for March did not depart far from the normal in any respect, though it was slightly cooler and drier than March generally gives in some places. The storms were not so severe as are many times experienced, and the snow gave a good covering on the fields and pastures, except along the immediate coast, until near the end of the month.

April departed very little from the normal in temperature, although it was slightly warmer in central counties; but an excess of rain came, except in the extreme south-east. The storms of the 8th–9th and 13th–15th filled the ground and reservoirs; and the intervales on rivers rising in the north were badly washed by the floods that came from the melting snow and extremely heavy rainfalls which fell there. In the Berkshire hills the highways were badly blocked by snow-drifts till after the 15th of the month.

May was much warmer than is usual; the temperature range for the month was great, and the daily changes large and rapid. A sharp frost occurred in eastern sections on the morning of the 2d, the temperature falling several degrees below freezing. General and heavy frosts occurred on the 14th and 17th and local frosts on the 19th and 22d. Snow was seen on the tops of the Berkshire hills on the 15th. The precipitation was considerably below the normal, except in the south-eastern counties, and was generally insufficient for the proper nourishment of crops. The rainfall was fairly well distributed throughout the month, and amounted to from one and one-half to two and one-half inches in all north-eastern, central and western counties, and from three and one-half to nearly five inches on the Cape and the Island of Nantucket. In western towns the springs and streams were reported to be the lowest for the season for many years. There was more than the usual amount of sunshine, and a marked absence of heavy rain and wind storms. Dr. Jabez Fisher of Fitchburg reported apple bloom on the 12th, — three days later than in 1894, but eleven days earlier than the average for thirty-nine years.

In northern counties occasional showers fell during the month of June, and the top of the ground was moist enough for most purposes; but in all central and southern districts not more than a trace of rain came from the 6th to the 25th, and the ground got very dry, but the cloudy, wet weather of the last week changed the aspect of everything. At most places the total rainfall for the month was slightly below the normal. A hail-storm in the vicinity of Warren, in Worcester County, on the 23d, did considerable damage. Some of the hailstones were as large as hen's eggs. At Blandford a severe hail-storm occurred in a limited strip on the 25th, cutting down and almost destroying all crops. A high wind accompanied the thunder-storm on the 29th, near Leeds, in Hampshire County, and did some damage to heavy grass, potatoes and corn. The temperature was slightly above the normal for the month in eastern districts, and considerably so in central. The warmest day at most places was on the 2d. Most correspondents reported a marked scarcity of the insect-eating birds, such as the bluebird, phœbe, robin and thrush; while the seed-eating birds, like the warblers, flycatchers, sparrows, etc., were nearly as plenty as usual. The scarcity of the first-named birds was probably due to the severe cold in the southern part of the United States last winter, as most of those birds winter there. Not only were the birds probably killed, but many insects that they feed on were also destroyed.

The weather for July was cool and unusually cloudy and rainy. The actual amount of rainfall was less than the normal for the month at many places, especially in the south-east, but the total number of rainy days was in excess. At Boston rain fell to an appreciable amount on twelve days, while a trace was recorded on two other days. The total fall, however, was half an inch less than normal, being 3.59 inches. The temperature was generally lower than usual, with few oppressive days, and no extended spell of hot weather. The cyclonic and anti-cyclonic areas were all of slight energy and poorly defined, except the last two cyclones. One of these passed north-easterly across our district on the night of 27th–28th, giving heavy rain and high winds; the other passed easterly to the north of New England on the 30th–31st, with heavy rain and severe local storms. Other sharp local storms occurred, but they were of short duration and confined generally to limited districts.

On the 13th much damage was done by hail in Hampshire and Worcester counties. On the 9th 4.13 inches of rain fell at Fitchburg in three and one-fourth hours. In one and three-fourths hours 3.37 inches of the amount was recorded. Dr. Jabez Fisher, who reported the fall, stated that it was unprecedented in his thirty-one years of observation.

Generally the weather during August was very favorable for vegetation and for farm work. Unusually low minimum temperatures were recorded, and the maximum was not so high as is usually experienced. At the Weather Bureau Office in Boston the temperature was below the normal on the 1st–3d, 12th, 13th, 20th–22d and on the 30th, and was above on all the other days. The warmest spells were from the 4th to 11th and from the 23d to 28th. The lowest temperature was on the 22d, when light frosts were general in low lands all over the State. There was plenty of sunshine, few severe thunder-storms or heavy damaging rains and a rainfall slightly below the usual amount at most places. At Boston the deficiency amounted to about one and one-fourth inches, but at Springfield to only three-fourths inch. At the former station only three thunder-storms were noted.

September was warmer than usual, with less precipitation and clouds and with generally pleasant weather favorable for ripening crops and harvesting. At Boston the mean temperature for the month was about 3.6° a day warmer than the normal. At Somerset the daily excess was about the same, and at Fitchburg it averaged 2° a day. The warmest spell of weather for the month, and at many places the warmest for the season, was on September 21–23. The maximum temperature was generally between 95° and 100°. The coldest spell was on the 14th to 16th at most places, when the mercury fell below 40° at many places and light frosts occurred in valleys. The precipitation was comparatively light in all sections, and at the end of the month water supplies were unusually low. No crops suffered seriously for want of water, although newly seeded land had not done so well as one would wish for and some late garden crops ripened prematurely. At Boston the rainfall was 1.64 inches less than the normal amount, and at Somerset the deficiency was 1.55 inches. Several severe thunder-storms, some of which were accompanied by hail, occurred during the month. During a thunder-storm at East Foxborough on the 9th a barn was struck by lightning and burned, with five horses, two cows and ten tons of hay.

Generally fair, cool weather prevailed during October over the greater part of the State, and harvesting was completed and fall ploughing carried on under favorable conditions, except where the ground remained too dry in western counties. In the eastern part of the State the heavy rain of the 12th to the 14th filled up the ground and all reservoirs, and, although it delayed work on low land, it put the ground into first-class shape for ploughing and seeding generally. There was less than the usual amount of rainy weather and cloudiness, but in the eastern part of the State, owing to the heavy rainstorm referred to, the total for the month was considerably above normal. At Boston rain began at 1.55 P.M. on the 12th and continued till 4.30 A.M. of the 14th, and in that time occurred the heaviest continuous rainfall ever recorded at the weather bureau station there. The total amount was 5.64 inches, 4.85 inches falling from 8 P.M. on the 12th to 8 P.M. on the 13th. Immediately surrounding Boston the fall was greater than at that station, but in the south-eastern part of the State very little came, and in western districts it was not out of the ordinary. At Framingham 8.49 inches was recorded by the Boston water works, and at other places between that town and Boston the fall was from 6 to 8 inches. The mean temperature was about 1.7 degrees per day below the normal at Boston, and there were few rapid or extreme changes and no spells of continued warm or cool weather. The first heavy frost of the season occurred at many south-eastern districts on the morning of the 11th. On October 6 an unusually high tide prevailed along the eastern coast, caused by a cyclonic storm that was moving northward far out to sea. It was one of the highest ever noted at Beverly Farms.

November was considerably warmer than usual, and in many sections ploughing and other farm work could be carried on continuously. A light fall of snow occurred on the 20th and a low minimum temperature was experienced on the 22d, but for the most part the ground was bare and free from frost. The cyclonic storms were generally of large area and marked energy, while the one which moved from the south-west up across the Lakes and down the St. Lawrence valley on the 25th and 26th was one of the most severe ever experienced. It gave from fifty to seventy miles of wind over New England. The rainfall was heaviest in eastern districts, but wells and reservoirs were well filled throughout the State. The Connecticut River overflowed its banks during the heavy local rains. Winter grains had entirely recovered from the effects of the drought, and the month ended with them in better condition than the average at the beginning of winter.

December, although having a higher mean temperature than the normal in most sections of the State, gave conditions unfavorable for fruit, winter crops and farm land in general. There was very little snow at any time, and during the first part of the month the ground froze and thawed frequently. During the last half the weather was unusually mild; ice disappeared from ponds and reservoirs, and the frost came out of the ground so that farm work could be carried on without trouble. The ground was in a very open and porous condition at the end of the month. The two storms which passed down the St. Lawrence valley on the 26th–27th and 30th–31st increased rapidly in energy, and both gave heavy rain and tremendous winds throughout our district. Considerable damage was done to fences, trees and farm buildings. The fog on the morning of the 21st in the vicinity of Boston was one of the most dense ever experienced there. Shipping was practically tied up in the harbor, and there were several accidents on the water. Trains on all the roads entering the city were from one to two hours late, and there were at least two collisions of trains, but happily without serious results. Thunder was noted on the 15th and on the 26th.

Meteorological Observatory of the Hatch Expepiment Station (Massachusetts Agricultural College), Amherst.

[Latitude, 42° 23' 48.5" N.; longitude, 72° 31' 10" W. Height of instruments above ground, 51 feet; above sea level, 260 feet.]

Annual Summary for 1895.

Pressure (in Inches).

Actual maximum reading, 30.55, Dec. 17, 10 A.M.
Actual minimum reading, 28.25, Feb. 8, 7 A.M.
Mean reduced to sea level, 30.076.
Annual range, 2.30.

*Air Temperature (in Degrees F.).**

Highest, 98, June 20; 97, Sept. 23.
Lowest, -6, -10, Feb. 6.
Mean, 48.5.
Annual range, 104; 107.
Highest mean daily, 83.4, June 2.
Lowest mean daily, 1.2, Feb. 6.
Mean maximum, 57.7; 58.8.
Mean minimum, 39.9; 35.3.
Mean daily range, 17.6; 23.4.
Greatest daily range, 41, 45, June 10.
Least daily range, 2, Dec. 5; 7, July 16.

Humidity.

Mean dew point, 39.5.
Mean force of vapor, 0.431.
Mean relative humidity, 74.4.

Wind, Prevailing Directions (Per Cent).

North-west, 13.
South, 12.
South-west, 14.
North, 10.
West, 9.
Other directions, 45.
Total movement, 46,861 miles.
Greatest daily movement, 454, Dec. 31.
Least daily movement, 0 miles, March 7.
Mean daily movement, 128.4 miles.
Mean hourly velocity, 5.3 miles.
Maximum pressure per square foot, 43 pounds=93 m. per hour, on Sept. 11, at 3 P.M.

*Precipitation (in Inches).**

Total precipitation, rain or melted snow =44.46.
Number of days on which .01 inch or more rain or melted snow fell, 119.
Total snowfall in inches, 61.

Weather.

Mean cloudiness observed, 49 per cent.
Total cloudiness recorded by the sun thermometer, 2,145 hours, or 47 per cent.
Number of clear days, 118.
Number of fair days, 110.
Number of cloudy days, 137.

Bright Sunshine.

Number of hours recorded, 2,363 hours=53 per cent.

Dates of Frosts.

Last, May 17.
First, Aug. 22.

Dates of Snow.

Last, April 3.
First, Oct. 20.

Gales of 50 Miles per Hour.

Jan. 27, 51 m., W.; Feb. 8, 71 m., N. W.; March 18, 63 m., N. W.; Sept. 11, 93 m., N. E.; Oct. 13, 53 m., N. E.; Oct. 17, 52 m., W.; Nov. 21, 67 m., W. N. W.; Nov. 26, 58 m., S. W.; Dec. 27, 69 m., W. N. W.; Dec. 31, 62 m., S. W.

Compiled by LEONARD METCALF, *Acting Meteorologist.*
JAMES L. BARTLETT, *Assistant Observer.*

Crops of the Year.

The season opened slowly and was later than usual at the end of March. The ground during April was cold, and no amount of seed had been put into it at the end of the month. Fall seeding generally wintered well. Promise of a light crop of grass on old meadows and dry fields, owing to drought and frost. Apple bloom rather light, it being the off year; but the bloom of pears, peaches, etc., was generally large. Great damage was done to the new growth on grapes, to grass, fruits, vegetables, corn and potatoes by the general frosts of the 14th and 17th of May. Moisture generally insufficient for the proper nourishment of crops, and grass suffered in particular. On the whole, the month was favorable for the forwarding of farm work and the outlook for crops was encouraging. Canker-worms quite prevalent; other insect pests, except cut worms, not particularly troublesome. Supply of farm help generally equal to demand, but the proportion of really good help was as usual small. Twenty dollars per month and board or $1.50 per day without board considered a fair average of wages paid good help.

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* The first figures denote readings at top of tower, the second at base.

July 1 cut worms were reported as causing considerable trouble, particularly in the Connecticut valley. Indian corn was reported as having stood the dry weather better than most crops, and looking well, stand and color both being good, with a general increase in acreage. Haying had begun, with the probability of a light crop. The cloudy, wet weather the last week changed the aspect of everything, and even grass, except on the driest knolls, thickened up and began to grow with new energy. Considerable cut grass was injured in the field. Early potatoes looked well in most sections. Early market-garden crops generally slightly below average in both yield and price. Quantity of dairy products about average, with slight but general decrease in the prices received. Pastures generally short and dry. Strawberries, blackberries and raspberries light crops, owing to late frosts and drought.

August 1 little damage from insects was reported. Horn flies and other flies quite troublesome in many localities. Indian corn in excellent condition; about the usual amount grown for the silo. The rains materially helped the hay crop, which proved to be about three-fourths of an average. Much of that cut early was damaged by rain, otherwise quality as a rule excellent. All fodder crops almost universally reported as in good condition. Market-garden crops generally improved by rains. Early potatoes looked finely.

Pastures improved very much during the month. Rye a good average crop, and in many sections excellent. Oats considerably above average. Barley a full average crop. Considerable damage done to crops at Warren and Blandford by hail on the 13th.

September 1 grasshoppers were reported as doing considerable damage to pastures and mowings, particularly in the western counties. Rowen promised to be a fair average crop. Winter apples generally reported to be a very poor crop. Potatoes promised to be considerably above the average in nearly all localities; considerable complaint of rot and prices low. Indian corn in good condition, with large stover and well set with ears. Sweet corn an excellent crop. All kinds of soiling crops reported in excellent condition. Pastures improved, but hardly recovered from the drought of the early part of the season. Oats better than last year. Tobacco crop of large growth, with a large leaf of fine color, remarkably free from imperfections and secured in excellent condition. During August crops ripened well, and the conditions were very favorable for harvesting and summer ploughing.

October 1 weather for September excellent for harvesting. Hardly enough moisture in the air. Cranberries, tomatoes and apples scalded by hot sun on the 21st–23d. Corn crop unusually large and of generally excellent quality. Potatoes more than an average crop, of generally good quality. Potato rot prevalent, but not to a dangerous degree. Root crops promised well. Apples very light in all sections and of rather poor quality. Pears and peaches large crop of generally good quality. Grapes a good average crop of good quality. Cranberries a little below an average crop.

November 1 fully three-fourths of the correspondents spoke of root crops as average and over half the remainder as above average. Turnips were almost the only one spoken of as below average. Farm stock was generally spoken of as being in good condition. Pastures, while not first class, had been generally fair, and where there had been a deficiency in pasture feed the condition of the stock had been kept up by feeding at the barn. Fall seeding reported as not up to the average in condition. Drought delayed seeding very much, and that which was put in did not progress very fast. Later rains have helped it very materially.

Thirty-eight of the 104 correspondents making returns November 1 considered hay to have been among the most profitable crops; 33, corn; 16, potatoes; 11, tobacco; 9, dairy products; 5, oats; 4, apples, cabbages and cranberries; 3, asparagus, etc.

Forty-eight correspondents gave potatoes as among the least profitable crops; 17, apples; 12, onions; 7, cabbages; 6, hay; 4, corn; 2, beans and strawberries, etc.

Massachusetts Crop Reports.

The publication of monthly crop bulletins was continued as in previous seasons, and six in all were issued (May–October), aggregating 190 pages of printed matter. Twenty-two hundred copies of Nos. 2, 3 and 6, 2,300 copies of No. 1 and 2,400 copies of Nos. 4 and 5 were printed and distributed. The bulletins were made up as in 1893 and 1894. The special subjects treated were: Bulletin No. 1, "Tuberculin, — what it is; how it is used; what it does;" Bulletin No. 2, "Hints on land drainage;" Bulletin No. 3, "Birds as protectors of orchards;" Bulletin No. 4, "The San José scale;" Bulletin No. 5, "Insecticides." These special articles will be found printed on pages 341–393 of this volume. Bulletin No. 6 contained an index to the bulletins of the years 1893, 1894 and 1895. Also, as in the past three years, this office co-operated with the New England Weather Service in the issuing of weekly weather-crop bulletins. The first was of date of May 6 and the last of date of October 7, 23 in all, representing an aggregate issue of 58,000 copies.

Publications.

The following publications were issued under the supervision of this office during the calendar year 1895: —

	Pages.	Number.	Date of Issue.
Agriculture of Massachusetts, 1894, .	968*	15,000	May 6.
Supplement to farm catalogue, . .	4	420	March 28.
Crop Bulletin, No. 1, May, . .	32	2,300	June 10.
Catalogue of Abandoned or Partially Abandoned Farms, reprint, fifth edition, ...	161	500	June 20.
Crop Bulletin, No. 2, June, . .	32	2,200	July 6.
" " No. 3, July, . .	32	2,200	August 5.
" " No. 4, August, . .	32	2,400	September 7.
" " No. 5, September, .	32	2,400	October 7.
" " No. 6, October, . .	32	2,200	November 4.
Regulations of Board, speakers and subjects, farmers' institutes, . .	8	500	November 6.

LEGISLATION.

The legislation of the year 1895 that had reference to the Board of Agriculture or to the agricultural societies was: "An Act to increase the annual appropriation for the work of the Dairy Bureau of the State Board of Agriculture" (Acts of 1895, chapter 214); "An Act to provide for the payment of bounties to chartered poultry associations in certain cases" (Acts of 1895, chapter 351); "An Act to authorize the Massachusetts Horticultural Society to hold additional real and personal estate" (Acts of 1895, chapter 353); a "Resolve providing for printing the special report of the State Board of Agriculture on the work of the extermination of the ocneria dispar or gypsy moth" (Resolves of 1895, chapter 23); a "Resolve providing for printing additional copies of the report of the Cattle Commissioners" (Resolves of 1895, chapter 22); a "Resolve to provide for continuing the work of exterminating the gypsy moth" (Resolves of 1895, chapter 82).

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* Including annual report of Director of State Agricultural Experiment Station, 487 pages.

APPROPRIATIONS.

OBJECTS FOR WHICH APPROPRIATED.	1893.		1894.		1895.		1896.
	Appropriated.	Used.	Appropriated.	Used.	Appropriated.	Used.	Appropriated.
Bounties to societies,	$21,000 00	$20,982 45	$21,000 00	$20,629 80	$21,000 00	$20,606 20	$21,000 00
Travelling and necessary expenses of the Board,	1,900 00	1,630 77	1,900 00	1,787 85	1,900 00	1,509 93	1,900 00
Travelling and necessary expenses of the secretary,	500 00	459 22	500 00	490 46	500 00	481 40	500 00
Incidentals in office of secretary,	600 00	600 00	700 00	700 00	700 00	700 00	800 00
Salaries of secretary and clerks,	5,300 00	5,300 00	5,300 00	5,300 00	5,300 00	5,300 00	5,300 00
Dissemination of useful information in agriculture by means of lectures or otherwise,	2,550 00	2,550 00	2,650 00	2,650 00	2,650 00	2,650 00	2,800 00
Printing 15,000 copies of the "Agriculture of Massachusetts,"	6,052 26	6,052 26	5,965 67	5,965 67	5,836 33	5,836 33	* 5,800 00
Collecting and circulating information relative to abandoned farms,	1,000 00	280 78	† 719 22	644 23	–	–	* 1,000 00
Carrying forward work of Dairy Bureau,	4,000 00	3,336 90	4,000 00	4,000 00	7,000 00	6,477 68	7,000 00
Salary of executive officer of Dairy Bureau,	500 00	500 00	500 00	500 00	500 00	500 00	500 00
Salary of assistant in work of Dairy Bureau,	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00
Nails or spikes for marking shade trees for preservation,	100 00	100 00	200 00	198 72	200 00	199 34	200 00
Printing 5,000 copies synoptical and analytical index to the "Agriculture of Massachusetts,"	1,400 00	1,400 00	‡ 393 36	393 36	–	–	–
Aggregates,	$46,102 26	$44,392 38	$45,028 25	$44,460 09	$46,786 33	$45,460 88	$48,000 00

* Estimated. † Balance. ‡ Deficiency.

Also, $150,000 was appropriated to be used in the extermination of the gypsy moth. An appropriation of $200,000 for this work has been asked of the Legislature of 1896.

NAILS FOR MARKING TREES.

The work done in this line has been of the same character as in past years. The appropriation for this purpose was $200, which has been used as follows: —

14 kegs M spikes, 3¼ inches, 2¾ inches and 2¼ inches, at $6,	$84 00
950 pounds galvanized-iron washers, at 12 cents,	114 00
Freight and cartage,	1 34
	$199 34

Nails and washers in varying quantities have been supplied, on application, during the year, to the towns of Billerica, Gardner, Groton, Harvard, Holliston, Lancaster, Lincoln, Natick, New Salem, Pepperell, Shirley, Stow, Sunderland, Templeton and Westborough.

Since the work of supplying these nails was begun, Dec. 26, 1891, 3 cities and 49 towns have availed themselves of the provisions of the act. In all there have been furnished to date 7,026 three and one-fourth inch nails, 56,535 two and three-fourths inch nails, and 44,958 two and one-fourth inch nails, making a total of 108,519.

ABANDONED FARMS.

A summary of the work of this office on the matter of abandoned farms shows the following results: the "Act authorizing the State Board of Agriculture to collect and circulate information relating to abandoned farms" was approved May 4, 1891 (Acts of 1891, chapter 280). Under this act five editions of a catalogue of such farms have been issued, in all aggregating 11,000 copies. The following table indicates the work done and some of the results secured: —

COUNTIES.	Number of Abandoned or Partially Abandoned Farms reported.	Number of Owners or Agents making reply.	Number not replying to Request for Description.	Number stating They did not care to sell.	Number reporting Informant to have been misinformed.	Number of Letters returned unclaimed by Post Office Department.	Number of Farms reported sold in Reply to Request for Description.	Number of Descriptions of Farms received.	Number of Descriptions withdrawn from Catalogue.	Number of Advertised Farms sold.
Berkshire, . .	264	147	117	10	12	19	5	120	10	37
Franklin, . .	168	80	88	11	10	8	3	56	10	20
Hampshire, . .	146	66	80	13	5	7	3	45	9	14
Hampden, . .	207	104	103	16	6	3	3	79	9	28
Worcester, . .	425	241	184	28	37	20	20	156	28	56
Middlesex, . .	59	32	27	4	4	4	3	21	4	8
Essex, . . .	12	4	8	2	–	2	–	2	–	1
Suffolk, . . .	–	–	–	–	–	–	–	–	–	–
Norfolk, . .	44	29	15	5	6	5	3	15	3	8
Bristol, . . .	100	37	63	13	7	7	2	15	3	4
Plymouth, . .	85	35	50	4	1	2	4	26	4	16
Barnstable, . .	45	16	29	2	1	3	1	12	2	4
Dukes, . . .	11	9	2	2	1	–	–	6	–	1
Nantucket, . .	10	6	4	2	1	–	–	3	–	1
Aggregates, .	1,576	806	770	112	91	80	47	556	82	198

Only $1,141.50 of the original appropriation of $2,000 was used; the balance, $858.50, reverting back to the State treasury at the end of the second year, Dec. 31, 1892. By chapter 46 of the Resolves of 1893 a further appropriation of $1,000 was made. Of this latter appropriation $74.99 reverted back to the State treasury, Dec. 31, 1894. No appropriation was asked of the Legislature of 1895 to continue the work. However, as several descriptions of farms were received soon after the publication of the fifth edition, it was decided to print a supplement and include them therein. This was accordingly done, and 400 copies of a four-page pamphlet, containing 12 descriptions, was issued, March 28, at a cost of $4.25, which amount was paid out of the appropriation for incidental expenses in the office of the secretary. Also, the supply of copies of the fifth edition becoming exhausted, it was decided to reprint 500 copies (the matter being stereotyped), and June 20 these copies were issued, at an expense of $96.25, which was also paid out of the appropriation for incidentals. Again in the fall of 1895 it was thought best to mail a return postal card to each party having description in the catalogue, asking if said farm or farms had been sold, and if so, date of giving of papers, name of purchaser, his residence at time of buying and the use he proposed to make of the property. The expense of this amounted to $6.08, and was paid from the appropriation for dissemination of useful information in agriculture. Believing that there should be funds available for continuing this line of work, should such continuance at any time be deemed advisable, it is recommended that the Legislature be asked to appropriate one thousand dollars therefor.

Scales of Points.

The secretary has supplied scales of points or score cards when called for at the expense of the societies ordering, as in the year 1894. Quite a supply of those printed that year were left over, and it has been only necessary to print 1,000 copies of the score card for horses and 1,000 of that for poultry, at an expense of $2.92. Scales in varying quantities have been supplied on request the past year to eight of the Massachusetts agricultural societies, to two societies in the State of Maine, one in New Brunswick, and to individuals and corporations in the States of Massachusetts, Maine, Vermont, Connecticut, New York, Iowa, Missouri, Pennsylvania, Ohio and Illinois, and also New Brunswick, Nova Scotia and Ontario. The receipts for scales sold amounted to $16.06. Quite a quantity of the cards still remain in the office of the secretary.

Farmers' Institutes.

Massachusetts provides liberally for the encouragement of agricultural societies, by a bounty of $600 to each society incorporated in accordance with the laws of the State, and which performs the duties imposed by such laws and complies with the regulations of the State Board of Agriculture. Among the regulations imposed by the Board is the following: "Each agricultural society receiving the bounty of the Commonwealth shall hold within its limits not less than three farmers' institutes each calendar year, and the Board shall render all assistance in its power to make such institutes interesting and profitable. The secretary of the Board shall also attend these institutes, so far as is compatible with the duties of his office, and he shall provide lectures for the institutes, so far as the appropriation for this object will warrant. . . ."

The Board of Agriculture has thought it best to in this way make use of these societies which receive the State's bounty, for the purpose of disseminating useful information in agriculture by the farmers' institutes, in addition to the information that is spread by the comparison of exhibits at the cattle show and fair. The 35 societies receiving bounty cover the whole State, and the 105 institutes annually required to be held by these societies bring the latest axioms of agriculture to the doors of nearly all the farmers of the State. This plan puts upon the societies the duty of selecting subjects and speakers, appointing time and place and advertising the institute, while the secretary of the Board engages the speaker and pays him from the State appropriation for dissemination of useful information in agriculture.

Past experience has taught that a farmers' meeting, to be appreciated, must have a distinctly local flavor; and, as a rule, the most successful institutes are those held by the societies in connection with a grange or farmers' club. In such cases the farmers' club or grange generally provides a dinner, often charging a nominal price for it. The ladies of the club or grange furnish the material, and the sum received goes into their treasury. In this way the people in the locality feel a personal interest in the institute, insuring a large attendance and better results.

Occasionally an institute is held simply because the society is required to hold it, but the number of this character grows less each year. More interest is awakened each year, and better speakers and more vital subjects for discussion are demanded from year to year. Other States pursue different methods; some of them employ a director of institutes to make all arrangements; but it is believed that in no other State is the whole territory more thoroughly served with the same expense.

Our societies held 118 institutes in 1895. During the year this office furnished speakers for 97, at an expense of $1,238.39, an average of $12.76+. In November, 1895, a pamphlet was issued, for the use of officers of societies and institute committees, containing the regulations of the Board of Agriculture concerning the holding of farmers' institutes, and also containing a list of available lecturers and their subjects.

TUBERCULOSIS.

The matter of dealing with contagious diseases among the domestic animals of Massachusetts is by law placed with the Board of Cattle Commissioners. An abstract of the report of this Board is by law required to be printed with the report of the secretary of the Board of Agriculture, and the same will be found on pages 425–557. The work of the Cattle Commission and the law under which they work have been criticised severely by many people, and, although the matter is outside the jurisdiction of the Board of Agriculture, it is of such great importance to the farming community that some reference may properly be made to it.

The law of 1895 granted practically full compensation for all Massachusetts cattle found diseased with tuberculosis and condemned by the Cattle Commission. It also provided that the expense of quarantine after ten days should be borne by the State. The expense of examination of the cattle and enforcement of the law is also borne by the State. The law of 1895 also provides that "Until June first, eighteen hundred and ninety-six, the use of tuberculin as a diagnostic agent for the detection of the disease known as tuberculosis in domestic animals shall be restricted to cattle brought into the Commonwealth from any point without its limits and to all cattle held in quarantine at Brighton, Watertown and Somerville: *provided*, *however*, that tuberculin may be used as such diagnostic agent on any animal or animals in any other portion of the State upon the consent in writing of the owner or person in possession thereof and upon any animals condemned as tuberculous upon physical examination by a competent veterinarian."

This restriction of the use of tuberculin was enacted on the demand of cattle owners.

Massachusetts has certainly dealt generously with the owners of cattle in her legislation for the suppression of tuberculosis. It appears that the law is at present working well, and that the Cattle Commission has requests on file for the inspection of more herds than can be inspected under the present appropriation. Consequently, a continuation of the restriction upon the use of tuberculin can for the present do no harm; but, in order that the State may not lose the benefits that should be realized from the expenditure of her appropriations for the reduction of tuberculosis, it would seem that the Cattle Commission should be empowered and required to test whole herds in which one or more diseased animals have been found, and that the commission should be empowered to require owners of herds in which one or more tuberculous animals have been found to make such changes in their stables and stable management as shall seem to be necessary to secure to their cattle the conditions known to be essential to health; also, that full compensation for an animal or animals found to be tuberculous upon any inspection subsequent to the first, should be allowed only when it shall appear that the owner has faithfully endeavored to carry out the changes he has been desired by the commissioners to make.

At the business meeting of the Board, held at Dalton, Dec. 3, 1895, the Board indorsed the changes above recommended in the laws for the control of contagious diseases among domestic animals. The record of the action of the Board may be found on page 10 of this volume.

Gypsy Moth (*Ocneria dispar*).

The Legislature of 1895 appropriated $150,000 for the continuation of the work of exterminating this pest. The law, chapter 210 of the Acts of 1891, requires the State Board of Agriculture to keep a record of its transactions and a full account of all its expenditures under this act, and by its chairman or secretary to make report thereof, with such recommendations and suggestions as said Board shall deem necessary, on or before the fourth Wednesday in January to the General Court. The annual report of the committee of the Board in charge will be found printed on pages 199–237 of this volume. At the annual meeting, Feb. 5, 1896, the following committee was elected to have charge of the work the present year: Messrs. E. W. Wood of West Newton, Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury, S. S. Stetson of Lakeville, John G. Avery of Spencer and the secretary.

Dairy Bureau.

On account of the expiration of his term of service as member of the Board of Agriculture, the chairman of the Bureau, Mr. C. L. Hartshorn of Worcester, ceased to be a member of the Bureau Feb. 4, 1896, and on February 5, Mr. D. A. Horton of Northampton was elected chairman. His Excellency has appointed Mr. J. Lewis Ellsworth of Worcester, Mr. Hartshorn's successor on the Board, member of the Dairy Bureau. The fifth annual report of the Bureau to the Legislature will be found printed on pages 239–260 of this volume.

Agricultural College.

The report of the examining committee of the Agricultural College will be found printed on pages 305–314 of this volume. Attention is also called to the lecture on "How the Agricultural College and Experiment Station benefit the farmer," by Dr. J. B. Lindsey of the class of 1883, and expert in charge of the department of foods and feeding of the Hatch Experiment Station of the college. This lecture will be found printed on pages 138–159 of this volume. The annual report of the Experiment Station is by law bound with the report of the secretary of the Board of Agriculture in this volume.

Returns of Societies.

These returns will be found printed on pages 263–292. A summary, contrasting the totals of 1893, 1894 and 1895, is printed on page 293.

Agricultural Directory.

A directory of the agricultural organizations of the Commonwealth, with officers for 1896, has been prepared, and will be found printed on pages 397–409 of this volume.

Cattle Commission.

Section 51 of chapter 491 of the Acts of 1894 provides that an abstract of the report of the Board of Cattle Commissioners to the Legislature shall be printed in the annual report of the State Board of Agriculture. An abstract of said report for 1895 will be found printed on pages 425–557 of this volume.

Meetings of the Board.

The public winter meeting of the Board for lectures and discussions was held at Dalton, Dec. 3, 4 and 5, 1895. The lectures and discussions will be found printed on pages 15–197 of this volume. A special business meeting of the Board was held at Dalton, Dec. 3, 1895, an account of which will be found printed on pages 9–12. The annual business meeting of the Board was held at the office of the secretary, Feb. 4, 5 and 6, 1896, and the minutes thereof, etc., will be found printed on pages 297–338 of this volume.

FARMERS' NATIONAL CONGRESS.

The report of the delegates to the Farmers' National Congress at Atlanta, Ga., Oct. 10–16, 1895, will be found printed on pages 413–424 of this volume.

CHANGES IN THE BOARD.

During the past year death removed from the Board Mr. William Bancroft of Chesterfield, who had represented the Hillside Agricultural Society on the Board since February, 1890. The resolutions on his death will be found printed on page 10. The delegate of the Attleborough Agricultural Association, Mr. Isaac Alger of North Attleborough, retired from the Board after five years of service, because his society had ceased to be entitled to representation on the Board. The following gentlemen retired from the Board because of the expiration of their terms of service: Chas. E. Ward of the Deerfield Valley Society, after three years of service; Henry A. Barton of the Highland Society, after three years of service; and C. L. Hartshorn of the Worcester Society, after twelve years of service.

WM. R. SESSIONS,

Secretary of the State Board of Agriculture.

BOSTON, February, 1896.

MEETINGS OF THE EXECUTIVE COMMITTEE

OF THE

BOARD OF AGRICULTURE,

1895.

MEETINGS OF THE EXECUTIVE COMMITTEE,

ACTING FOR THE BOARD.

Boston, May 24, 1895.

The meeting was called in part to consider the request of the Middlesex North Agricultural Society for the approval by the Board of Agriculture of the vote of said society authorizing the treasurer to execute in the name of the society a mortgage on the real estate of the society to the Lowell Institution for Savings, to secure a loan of nine thousand dollars, authorized by vote of the members, May 8, 1895, said approval being required under chapter 274 of the Acts of 1890. A certified copy of the records of the meeting of the society, at which it voted unanimously to mortgage the property of the society for the sum of nine thousand dollars, was furnished the committee by the secretary, Mr. Geo. B. Coburn. In accordance with the requirements of chapter 274 of the Acts of 1890, the executive committee duly advertised that a hearing would be given to interested parties; said advertisement appearing in the "Lowell Daily Courier" and "Lowell Daily Citizen," newspapers published in Lowell, one insertion of the notice having been at least one week before the date of hearing. No person appearing in opposition to the request for approval of the vote, it was

Voted, To approve the vote of the Middlesex North Agricultural Society, passed on May 8, 1895, authorizing the treasurer to execute a mortgage of the real estate of said society, situated in Lowell, for the sum of nine thousand dollars, to the Lowell Institution for Savings, and that the secretary be instructed to notify the society of this action.

W. C. Baylies, Esq., president of the Bristol County Agricultural Society, presented the request of said society for the approval by the Board of Agriculture of the vote of said society, Nov. 17, 1894, authorizing the directors to acquire or convey real estate in order to lay out a street connecting Agricultural Avenue with Highland Street. It appeared from a copy of the records of the society, attested by the secretary, that the society passed the vote above referred to by the affirmative vote of two-thirds of the members present and voting at a meeting duly called for the purpose. It was therefore

Voted, That the society be directed to advertise a hearing of the parties interested, by the Board of Agriculture, and that, if no person appears at the hearing to object, the secretary is hereby authorized to record the approval by the Board of Agriculture of the vote of the Bristol County Agricultural Society, and that the secretary notify said society of the action of the Board.

Voted, That the executive committee of the State Board of Agriculture desire to express to the family of the late General Cogswell, Representative in Congress from the Sixth District, their appreciation of the loss which they feel at his death. He has invariably shown deep interest in the agricultural affairs of Massachusetts, both while in the State and national governments, and has always been active in advising with, and executing the wishes of, this Board in matters of legislation. They desire to convey to his family their sincere sympathy in their recent loss. The secretary is directed to send a copy of this vote to the family of the deceased.

BOSTON, May 31, 1895.

Copies of the "Taunton Gazette" having been received, showing three insertions of an advertisement of a hearing of parties interested in the conveyance of real estate by the Bristol County Agricultural Society, one of which was at least one week before the time of said hearing, and no person appearing to object to the approval by the Board of Agriculture of the vote of said society authorizing such conveyance, according to the vote of the executive committee, May 24, the approval of the Board of Agriculture was given to the vote of the Bristol County Agricultural Society, that the Board of Directors be authorized to acquire or convey real estate in order to lay out a street connecting Agricultural Avenue with Highland Street, and a certificate to that effect was sent by the secretary to Mr. W. C. Baylies, president of the Bristol County Agricultural Society.

BOSTON, Aug. 13, 1895.

A request having been received from Mr. F. H. Newell, Washington, D. C., secretary of the American Forestry Association, for the appointment of a delegate to represent this Board at the meeting of the American Forestry Association in Springfield, Mass., Sept. 3 and 4, 1895, the executive committee this day appointed Mr. Francis H. Appleton of Peabody the said delegate.

WORCESTER, Sept. 4, 1895.

The meeting was called to consider the request of the Berkshire Agricultural Society for the approval by the Board of Agriculture of the vote of said society to authorize a committee to borrow money to pay the present indebtedness of the said society, and to sign a mortgage and notes therefor; to sell such portion of the society's grounds as they shall deem advisable, to sign deeds or other papers necessary, and to apply the proceeds to the indebtedness of the society. A certified copy of the records of the meeting of the society, at which it was voted unanimously to do the above-named acts, was presented by the president of the society, Mr. W. B. Barton, who also presented copies of the "Berkshire Eagle," containing the required advertisement of the hearing, one of the three insertions of the notice having been at least one week before the date of hearing. No person appearing in opposition to the request of the Berkshire Agricultural Society, it was

Voted, To approve the vote of the Berkshire Agricultural Society, passed Dec. 6, 1894, granting full power to a committee of said society to borrow money to pay the present indebtedness of the society, and to sign a mortgage and notes therefor; to sell such portion of the society's grounds as they shall deem advisable, to sign deeds or other papers necessary, and to apply the proceeds to the indebtedness of the society.

Voted, That the secretary notify the society of this action.

SPECIAL MEETING

OF THE

BOARD OF AGRICULTURE,

AT

DALTON.

DECEMBER 3, 1895.

SPECIAL MEETING OF THE BOARD OF AGRICULTURE, AT DALTON.

DALTON, MASS., Dec. 3, 1895.

The Board of Agriculture met at the Opera House, Dalton, this day, at 9.30 A.M., for business.

Present: First Vice-Pres. James S. Grinnell, who presided, and Messrs. Alger, F. H. Appleton, J. S. Appleton, Jr., Avery, H. A. Barton, Blair, Bourne, Brooks, Bursley, Clark, Clemence, Cook, Cruickshanks, Damon, Goessmann, Goodell, Gove, Hartshorn, Harwood, Hersey, Horton, Kilbourn, Lyman, Norton, Palmer, Pratt, S. M. Raymond, Reed, Sargent, Sessions, Francis Shaw, N. W. Shaw, Stetson, Taylor, Tucker, Ward, Wellington and Wood.

A draft of the annual report of the secretary of the Board to the Legislature was read by the secretary and discussed.

Voted, That the secretary be authorized to print in consolidated form the several essays printed in the Massachusetts Crop Reports of 1895, and publish the same separate from his annual report.

Voted, That the secretary be authorized to ask the Legislature to increase the appropriation for incidentals in the office of the secretary to eight hundred dollars, and the appropriation for the dissemination of useful information in agriculture to two thousand dollars.

Voted, That the secretary be authorized to petition the Legislature for one thousand dollars, under the act of the year 1891, "to authorize the State Board of Agriculture to collect and circulate information relating to abandoned farms" (Acts of 1891, chapter 280).

The matter of farmers' institutes, touched upon by the secretary in his report, was discussed by the chairman, the secretary, and by Messrs. Gove, Cruickshanks and Pratt, but no action was taken.

The matter of tuberculosis, referred to in the report of the secretary, was considered and discussed by the secretary and Messrs. Hartshorn, F. H. Appleton, Taylor, Horton, Barton, Ward, Alger, Harwood, Palmer, Blair, Grinnell, Stetson, Clemence, Tucker, Kilbourn, Goodell and Brooks.

Voted, That it is expedient to continue the present law, except that the Cattle Commission shall test whole herds in which one or more diseased animals have been found.

Voted, That a committee consisting of W. P. Brooks, C. L. Hartshorn and Francis Shaw take this matter into consideration, and report in due form a recommendation of the position to be taken by the Board as to the examination of herds in which animals have been found to be diseased with tuberculosis.

The above-named committee reported that the Board should recommend the following changes in the present law relating to tuberculosis: —

1. That subsequent to June 1, 1896, the use of tuberculin as a diagnostic agent shall be applied to all the animals of all herds in which one or more tuberculous animals have been found.

2. That all owners of herds in which one or more tuberculous animals have been found shall be required to make such reasonable changes in their stables and stable management as shall seem to be necessary to secure to their cattle the conditions known to be essential to health.

3. That full compensation for an animal or animals found to be tuberculous upon any inspection subsequent to the first shall be allowed only when it shall appear that the owner has faithfully endeavored to carry out the changes which he has been desired to make.

The recommendations of the committee were voted.

The chairman presented the following: —

Again one of our members has been removed by death.

William Bancroft of Chesterfield, the delegate to this Board from the Hillside Agricultural Society, died suddenly at his home on the farm where he was born, seventy-one years ago, respected and beloved not only in the immediate community where he lived but in a large circle of acquaintances and friends in the western part of the State.

Mr. Bancroft's father was a lawyer as well as a farmer, and much respected in the county. Our friend was born and reared on the farm, but early went into mercantile and commercial pursuits; but after many years of successful business, the love of the farm and of his boyhood's home brought him back to till the paternal acres. The house of his father where he was born having been burned, Mr. Bancroft built on the same spot a house and very fine barn, in which he took great pride for its beauty and convenience. It was on the floor of that barn, while attending to the farmer's early duties of feeding and caring for his cattle, that he dropped dead from paralysis of the heart at the age of seventy-one years.

In memory of him we would say that, while the community in which he lived has lost a kind neighbor, a willing assistant and a good and helpful counsellor, we mourn a greater personal loss. Mr. Bancroft became a member of this Board in 1890, and immediately took rank as one of the brightest, most intelligent and best informed of all our members. Ready and alert, he performed cheerfully, promptly and faithfully every duty assigned to him, while his genial presence and ready wit enlightened and brightened our meetings.

Resolved, That the secretary of our Board be directed to send a copy of this resolution to his family, and to the "Springfield Republican" for publication.

Commemoratory remarks were made by Messrs. Avery, Barton, F. H. Appleton, Pratt, Horton, Lyman, Ward and Tucker, and by Mr. Newhall of Conway, a former member of the Board.

On motion of Mr. Hartshorn, the resolution was adopted by a rising vote.

The report of the gypsy moth committee was then taken up and considered, and on motion of Mr. Hartshorn it was

Voted, That the report be accepted and adopted as the report of the Board to the Legislature.

Remarks upon the progress of the campaign against the gypsy moth were made by the secretary and Messrs. F. H. Appleton, Clark, Hersey, Wood, the chairman and Field Director Forbush.

Voted, That it is the opinion of the State Board of Agriculture that, to make the work of the gypsy moth committee effective and economical, in the interests of the Commonwealth, whatever, if any, appropriation is made in 1896 should be made early in the session of the Legislature, so that the work can be conducted during the spring months with like activity to that of the other months.

Mr. Geo. M. Whitaker, assistant executive officer of the Dairy Bureau, presented and read the annual report of the said Bureau to the Legislature, which, on motion of Mr. F. H. Appleton, was accepted and adopted as the report of the Board of Agriculture to the Legislature.

Voted, That the executive committee of the Board be requested to consider the expediency of again urging upon the Legislature the investigation of the quality of feed-stuffs, and that it be given full power to act as it may see fit.

Voted, That the report of the secretary be accepted and adopted as the report of the Board to the Legislature.

Adjourned.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE,

AT

DALTON.

DECEMBER 3, 4 AND 5, 1895.

PUBLIC WINTER MEETING OF THE BOARD,

AT DALTON.

The annual public winter meeting of the Board was held in the Opera House, Dalton, beginning Tuesday, December 3, and continuing through the two following days. There was a full attendance of the Board, and at most of the meetings there was a good attendance of farmers from Dalton and vicinity.

The first session was called to order by Hon. James S. Grinnell, the first vice-president, who introduced Mr. Henry A. Barton of Dalton as the presiding officer of the day, and the gentleman selected by the citizens of Dalton to welcome the Board of Agriculture to their town.

ADDRESS OF WELCOME.

BY MR. HENRY A. BARTON OF DALTON.

Mr. Chairman, members of the Board of Agriculture and friends: It is my privilege and great pleasure to extend to you, in a few brief remarks, for the inhabitants of this town, a most cordial welcome. Our town is nestled here among the Berkshire hills and valleys, and, like many other towns of this grand old Commonwealth, is the seat of varied industries. For more than a hundred years our farmers have faithfully followed the plough and tilled their farms, and for nearly the same length of time the manufacturer has been as faithful in his work. And side by side for this hundred years they have prospered together, each desiring to assist and to advance the welfare of the other.

From the fruits of the labors of these many years we rejoice as a town to-day in our free public schools and substantial school buildings, giving to our children those advantages which will fit them for the work of life equal in this country town to those that are enjoyed by many of our larger towns and cities. We rejoice also in our churches and in the pleasant church buildings, where with our families and friends we mingle our worship and our gratitude to the Giver of all good. We are grateful also for the privileges that come to us from our free public library, and also for the building in which we are gathered at this time. All of this we know is the fruit of honest toil and industry, and the gift to us from willing and generous hearts. We must not, however, rest on the record of the past, for we know that the grand work that Almighty God has given us to do is to reach out our hand on every side to our fellowman, and to encourage him in every honorable occupation to make the greatest improvement in his work and to use every opportunity to advance in all the departments of life. In the close competition that enters into all our business life to-day we must ever keep before our minds that educated industry is one of the first and most important elements of success, and, as has been so well said before, that educated industry is the protection of our youth. It is the glory of manhood; it is the base of our national wealth and prosperity.

And so we are very glad to welcome the State Board of Agriculture here to-day in the interests of our farmers. We know that you have come to us full of the enthusiasm of your special work, with all the best thought and experience of the year.

We are very glad also to welcome the representatives of our State Agricultural College and Experiment Station. We are grateful for the advantages that come to our farmers' boys from the Agricultural College, giving to them the opportunity to secure an education in accordance with the means of the farmers, — a college not only fitting them to be farmers but fitting them to be men in every department of life and useful in the community wherever they may be placed; fitting them to understand the business of their town, and enabling them to so educate themselves that they can well assist in the halls of legislation and to understand what we desire to carry forward in the interest of the agriculture of our State. As I said before, we welcome, too, the representatives of our Experiment Station, which gives to our farmers an idea of how best to cultivate their lands, how best to fertilize their crops, how best to understand and protect them, all of which has helped to advance agriculture, especially in the past few years.

And we rejoice to welcome the representatives of the grange, that mighty factor in our State and nation, which has brought happiness and comfort to so many of our farmers' homes, giving to them social and educational advantages and in a large measure the financial improvement which they have so much desired.

And we welcome also the representatives of our agricultural and daily press, and recognize what a mighty factor they have been and are to-day in advancing the cause of agriculture.

Our farmers to be successful must more and more bring thought and intellect into recognition, as well as nerve and muscle. Many of the farms of New England are rough and uneven and our winters are long and severe; and yet, if the farmer will give to his work the same thought, the same care, the same perseverance that men give to the work and management of other industries that are successful, he can give to his family a pleasant and comfortable home, he can educate his children to a reasonable extent and inculcate in them the principles of honesty, integrity and an upright life, which will help them as they go out into the world to assert their individuality and to be a help and a blessing to the community where they shall make a home.

We are very glad to welcome you all here to-day, and we desire very much to make your stay at Dalton a very pleasant one; and we hope that when this meeting is over and you shall separate and go to your homes, scattered all over New England, you will carry with you nothing but pleasant recollections of your meeting here.

But we rejoice most to-day in the good cheer and the encouragement which you bring to the farmers not only of our own locality but of all New England and the whole country. For who is there to-day who will not say that the farmer who has been faithful in his business, though he may not have accumulated more than a few thousand dollars, has not done as much for the real advancement of this dear old Commonwealth as any other man engaged in any other industry?

And now, with a prayer that the work of this session of the State Board of Agriculture may be fruitful of much that shall advance the cause of agriculture and add to the happiness and blessings of every farmer's home within our borders, I again extend to you all a most hearty and cordial welcome.

After the Oberon Ladies' Quartette of Laconia, N. H., had favored the audience with song, the chairman announced, as the subject of the afternoon, "How can boards of agriculture help the farmers?" and introduced Hon. N. J. BACHELDER, secretary of the New Hampshire Board of Agriculture, as the lecturer.

HOW CAN BOARDS OF AGRICULTURE HELP THE FARMERS?

BY HON. N. J. BACHELDER, CONCORD, N. H.

The people of New Hampshire have long been accustomed to look to the old Commonwealth of Massachusetts for examples of statesmanship in the various departments established and maintained by the State for the development of the interests represented. Especially has this been true in regard to the agricultural department, and we in New Hampshire have availed ourselves on several occasions of the agricultural thought and research as promulgated by your eminent agricultural specialists.

In view of these facts, we enter upon the discussion of this subject with no little hesitancy, augmented somewhat by the lack of much definite data upon which to base our conclusions. This latter condition may not be so much a misfortune to you as to the speaker, for sometimes originality carries with it a certain amount of interest, even if not entirely practical in its conclusions. In the discussion of this subject we shall refer to the work of no particular board of agriculture nor be guided by any statute law governing such boards, for we are addressing people who make laws as well as enforce them, and a sufficiently intelligent people to recognize the necessity of progress in the machinery that cultivates the mental; as well as the material, resources of the farmer. The methods in vogue at the time of the establishment of boards of agriculture may be no more applicable to the situation to-day than would be the farm machinery in use at that time to the present changed conditions. The fact, however, that the laws governing boards of this character generally confer such penal authority as to leave much latitude in the hands of those charged with their administration, has afforded some opportunity for progress under early enacted laws. In the consideration of this question it cannot be expected that we will discuss details to any great extent, for the time will not allow it. We will endeavor only to set a few landmarks along the pathway we would mark out for ourself and our esteemed agricultural co-workers.

The work of boards of agriculture may be classified as legislative, administrative and educational, each of which is susceptible of innumerable subdivisions penetrating the various ramifications of politics, business and society. By legislation we refer to the influence that should be exerted upon legislative leaders in the enactment of just and wholesome laws. We shall place this duty at the head of the list, as perhaps the most important of any, but not the most useful, for the reason that the position occupied by boards of agriculture entitles them to a more respectful and considerate hearing than is often accorded representatives of private or individual interests. We do not wish to be understood as advocating anything in the form of lobbying, but simply the matter of appearing before committees in behalf of the farmers when measures affecting the farmers' interests are pending, and intelligently presenting the claims of the agricultural interests. This will meet with favor by all legislators who desire to act understandingly and with due regard to the interests of the State. We would also have the interests of agriculture officially represented before the governor and executive council when action is to be taken directly affecting those interests. We would not advocate an effort to dictate the appointments that are to be made for the purpose simply of getting farmers appointed. We have no sympathy with that statesmanship which consists in advocating the appointment of farmers to positions simply because they are farmers. We would advocate principles rather than men, and would earnestly request the appointment of men representing those principles. Much injury has been done the agricultural cause in the past by demanding the recognition of men simply because they were farmers, rather than by standing upon the broad platform embodying a broad and well-defined purpose.

While we do not expect to see it accomplished at present, yet we believe the time is coming when agriculture, the fundamental interest of the country, will be represented on the executive council by statutory law. We have never yet heard any argument in favor of making the national secretary of agriculture a member of the president's cabinet that did not apply with equal force to making the executive officer of the State department of agriculture a member of the governor's council. He should be present to advocate principles rather than men, and be prepared to advise upon all matters relating to the agricultural interests. When this shall have been done we may not hear so much about the uselessness of an executive council.

There should be greater uniformity in legislation in different States in matters pertaining to agriculture, and boards of agriculture should secure this through the means of a national association. An annual convention should be held, where the executive officers could discuss these matters and inaugurate co-operative measures. There is no sensible reason why the owners of an animal condemned because tuberculous should receive nothing, one-half, two-thirds or full value, according to the State laws in the State in which they are located, when the real value must be the same in all. There is no reason why animals moved from one State to another should be submitted to the most strict and inconvenient test for disease, while animals passing in the opposite direction, with more danger of carrying disease, are moved with little or no restriction. There is no reason, at least as far as New England is concerned, why there should not be a uniformity of laws upon these subjects, and State boards of agriculture can help the farmers by bringing it about. Boards of agriculture can help the farmers in legislative matters other than those pertaining directly to agriculture. Such subjects as good roads, education and judicious economy in public expenditures should receive careful attention, not by a narrow, miserly policy, but by a broad, liberal, progressive course in the interest of the tillers of the soil. If the farmers are to be accorded that position in the world to which they are by right entitled, the position taken by their representatives must be in keeping therewith.

The administrative duties should include the administration of laws enacted having a direct bearing upon agriculture, now frequently requiring the services of a special commission. Such work as the suppression of contagious diseases among animals, the destruction of insect pests, the enforcement of laws against the fraudulent sale of imitation dairy products, the promotion of horticulture, dairying, forestry, wool growing, bee keeping and pomology, the oversight of fair associations, regulating the sale of commercial fertilizers and all similar supervision could well be done by the boards of agriculture, or bureaus established under their direction. This course will concentrate the forces and accomplish greater results with less expense. It will place the management of these different matters under the direction of those who have a direct interest in the results, and will make the managers of each directly responsible to a board having some knowledge of such matters. We would make the duties and powers of boards of agriculture as broad as the name implies.

Much can be done by boards of agriculture in popularizing agriculture by advocating its advantages. The abandoned farms of New England, about which so many thousand pages have been written and printed, have been widely advertised, and found many occupants through the administration by boards of agriculture of laws enacted for this purpose.

In this same line we would make boards of agriculture bureaus of information upon the condition and production of the farms. To this end we would have them authorized and provided with funds to take an annual census of the farm property, farm stock, crops and the opportunities for investment in agriculture. We would have included something in regard to the undeveloped water powers, mines and forest areas, and we would annually publish this information and distribute it widely. We believe that the faithful administration of such laws would add to the prosperity of the farmers, for the reason that anything that adds to the prosperity of a town adds to the opportunities for prosperity by all its citizens.

The educational work of boards of agriculture is the line of work susceptible of the greatest development of any. It is not within the legitimate province of governments, either State or national, to help the farmers except by adequate instruction to enable them to intelligently help themselves. This educational work is of so much importance that it will constitute the main feature of this address.

This educational work is easily subdivided into three classes, — institute, school and college work. The institute work of the boards of agriculture in all the New England States is an important feature of their duties, and is increasing in extent and usefulness each year. Boards of agriculture aid the farmers in this direction very materially, and their efforts are better appreciated than ever before. Much has been learned by institute managers in regard to qualifications of speakers for such occasions. They have learned that there is no demand for the political schemer, who wants to boom himself for office; for the inveterate talker, with more words than ideas; or the learned scientist, who may be familiar with every principle of his subject, but as ignorant of their application as the new-born babe. The man who attempts to interest farmers should be a practical man, and have experience along the line which he discusses. He should have sufficient theory to give intelligent reasons for his statements, and should be a specialist. When a speaker comes before an audience of farmers and tells them the most profitable method of doing certain things and the reasons for it, and is then able to say, "I have tried this, proved it and made a success of it," the farmers are at once ready to place confidence in his statements, and become interested in the subject under consideration. College professors sometimes fail to recognize the fact that farmers' institutes require different instruction from that given a class in college, and are sometimes entirely lacking in the practical application of the theories with which they are so familiar. When they are familiar with the practical application of the principles enunciated, college professors are valuable institute workers. The point we desire to make is, that instruction given at farmers' institutes should not be so scientific as to shoot over the heads of the audience, nor so intensely practical as to contain no information of importance. A happy medium between the two is an important object to be sought by boards of agriculture in arranging farmers' institutes.

The farmers' institutes when properly arranged and carried out are capable of helping the farmers more than any other feature of the work imposed upon boards of agriculture for the farmers' benefit. The institute work of boards of agriculture can be materially advanced by co-operating with the granges. There are no means so effectual in calling farmers together as the fraternal ties of this grand farmers' organization, and when assembled there is often a lack of just such instruction as is furnished by a good institute worker. Where there are no agricultural societies to form the basis of the farmers' institutes the grange should be appealed to, and when such co-operation has taken place we have always noticed grand results. It means larger audiences for the institute workers and a more useful meeting on the part of the grange for the instruction and entertainment furnished by the Board of Agriculture. It also promotes a spirit of harmony and good fellowship between the two organizations that is helpful to both. The position that the grange has lately taken, especially in New England, leaves no reason for boards of agriculture to encourage any but the most cordial relations, and he who harbors any other feeling than this should not complain if classed with the old fogies and mossbacks.

The educational influence possible to be exerted by boards of agriculture in the public schools and agricultural colleges of our land is beyond our faintest conception, and affects the welfare of succeeding generations.

Boards of agriculture must recognize the fact that education is a word of broad significance. The training of the intellect and all other God-given faculties is included in its sphere. Its limitations are as wide as the earth itself, and its power so extensive as to be incomprehensible. We are told that intellectual culture is the only remedy for intellectual paralysis; and we may claim with equal force that manual training is the most effectual remedy for physical inactivity, sometimes termed laziness, — for nothing stimulates a person to greater activity than the ability to do difficult things well. This intellectual culture is not the need of the professional man merely, but of all men in all vocations; and, when combined with manual training, makes the sailor go up from the forecastle to the quarter-deck, changes apprentice to master, the mill hand to agent, the laborer to employer, the journeyman to contractor, the scavenger to capitalist.

Education begins with the first spark of intelligence in the mind of the infant, and ends only with the departure of reason or life. It is the motive power that raises man above the brute creation, and, while it affords the means of acquiring a livelihood and perhaps wealth, ranks higher than wealth when subjected to a court of competent jurisdiction. However ornamental it may be, its usefulness depends upon its character, and this suggests a train of thought upon "practical education" which boards of agriculture should advocate for farmers' sons and daughters and all other industrial classes.

School days represent not the period of getting an education, but the period of laying the foundation of life study. It is asserted that but one person in thirty gets beyond the common school in educational institutions. How important it is, then, that our common schools be intensely practical in their instruction, and at least furnish the pupil with a correct foundation for life study and life work.

I desire to call the attention of boards of agriculture to an extract from an address on horticultural education, delivered not long ago by one of the teachers of Boston. He says: "A large majority of our public schools have done little or nothing in the study of plants, insects, minerals and soils, alleging that such studies are not practical. For years past we have been reaping the natural results of a system of education that, intentionally or unintentionally, turns all our young people for a livelihood towards the occupations of teachers, college professors, lawyers, physicians, clergymen, book-keepers, salesmen, musicians, artists, agents and business men, under which head multifarious and heterogeneous legions of middle-men are pleased to class themselves. These men have had the control of educational affairs, and they have kept the schools turning out their kind so long that there is unquestionably in this country an overwhelming surplus of middlemen, non-producers and men living by their wits. Such a surplus is certain to make trouble. All are determined to live affluently if possible, genteelly at all events."

The truth of this statement will be recognized by all who have given the subject any consideration. Do not misunderstand this. We do not decry culture. Intellectual training is to be prized, but practical knowledge is necessary to make it available. The experience gained from books is of the nature of learning, but the experience gained from practice is wisdom; and an ounce of the latter is worth a pound of the former. All history shows that the great acts in the development of a country have not been performed by men of fine culture. There were wise men in Europe before there were printed books.

At a gathering in Australia not long since four persons met, three of whom were shepherds on a sheep farm. One of these had taken a degree at Oxford, another at Cambridge, the third at a German university. The fourth was their employer, rich in flocks and herds, but scarcely able to read and write. Culture is valuable, but it requires business training with it to bring success.

We are glad to notice changes for the better, and to see needlework, cooking, manual training for boys and various forms of instruction in the practical work of life recently introduced in the common-school curriculum of the most progressive cities in the land.

We also desire to see the study of agriculture universally adopted in our public-school system. The vast majority of those whose school life ends with the district school are destined to be engaged in some branch of productive industry, — occupations in which manual skill is of primary importance. And yet we frame for these, to the exclusion of more useful studies, such courses as if their destination were to be the author's sanctum, and such programmes of geography as if they were intended to lead exploring expeditions into the centre of Africa; and the last instruction it has entered our head to give them is that which they will require in their daily life from the hour they issue from school. We contend that the art of reading can be acquired as easily from a series of lessons on the cultivation of fruit trees as from a series containing the oratory of Burke, and that the teaching of practical school gardening would be as valuable as setting the pupils to commit to memory the heights of the principal peaks of the Rocky Mountains. In European countries we find that this has already been done, and we refer you to England, France, Germany and Belgium for the success of the scheme. In the latter country, no larger than one of the New England States, we find four schools for higher agricultural education, thirty-three secondary schools with forty short courses in agriculture and numerous courses in agriculture in normal and primary schools.

While other nations are decreasing in their relative agricultural interests, France is working in the other direction. France spends for the encouragement of agriculture yearly $8,000,000. The farms of France are the best cultivated in the world, and her production per capita has doubled in half a century. In Paris is located the renowned Agricultural University; also three national schools of agriculture, one of horticulture, one of dairying, three of veterinary science, two of forestry and two shepherds' schools. We are told that the fifteen agricultural colleges in France educate seven hundred lads a year in the science and practice of agriculture, at eighteen pounds each. To these must be added a professorship of agriculture in each of the eighty-six departments or districts into which France is divided, with farm schools, experiment stations, fields and colonies. Besides all this, in 1850 agriculture was made optional in all public schools, and in 1859 a law compelled each normal school to prepare for teaching agriculture and to fit all the teachers of France for instructing in land culture.

In England we understand elementary education in agriculture has been introduced into the public schools, and the examination made by school officials includes an investigation of the proficiency attained by the scholars in the agricultural studies. Whatever the avocation in life, no girl or boy will suffer harm from elementary knowledge in these practical subjects. Austria spends annually $4,000,000 for the encouragement of agriculture and Germany $2,850,000. The amount annually appropriated by the United States government for this purpose is about $3,000,000, to which must be added a vast sum appropriated by States and bequeathed by individuals.

When, through the influence of boards of agriculture, this instruction in the elements of agriculture shall have been introduced in our public schools, there will be more students apply for admission in our agricultural colleges than in the past, and more will receive an honorable admittance to the business of husbandry, the foundation of all other industries, and, when intelligently managed, the highest industrial occupation open to mankind. The agricultural colleges of the country are capable of great things in advancing the interests of agriculture through the means of practical education.

The industrial classes which should receive the advantages of these institutions form a vast army, compared with the few that will ever avail themselves of the classical and literary colleges. It is therefore, my friends, of the greatest importance that you and I use every effort, even at this late day, to increase the usefulness and patronage of these institutions, and recommend them to farmers' sons and daughters. It was the intention of those who assisted in providing the means for establishing these schools that the education furnished should be of a practical nature, as related to the work of the farm and the shop. While they were expected to be something more than trade schools, they were not expected to be classed with the literary colleges of the land. There is abundant evidence that there is honor in serving the great class of common people who are fitting for the industrial pursuits of life by training the intellect and the hand at the same time, taking the boys and girls from the common schools and fitting them for the most skilful performance of life's work and for becoming useful and honorable citizens, — in short, giving them a practical education. Boards of agriculture must assist in advocating this.

It is sometimes asserted that it is impossible to determine for what a boy is best adapted, and hence he must get a general literary education, and then see in what direction his tastes lead him. The successful farmer knows the adaptation of all his farm animals; he knows the quality of soil in each of his fields, and to what it is best adapted; he studies the market and transportation rates. Is it unreasonable to suppose that he will have become so familiar with the nature of his children that their future career will be guided more safely by him rather than by allowing them to choose from their own inclinations? We are told that there was once a man who, wanting to learn for what profession his son was best adapted, finally hit upon the expedient of shutting him up in a room with a Bible, an apple and a dollar bill. For he reasoned thus: If on his return he found him reading the Bible, he would make a minister of him; if eating the apple, a farmer; and if playing with the dollar bill, a banker. Well, as the story goes, when he returned he found the boy had solved all difficulties. He had pocketed the dollar bill, had eaten the apple and was sitting on the Bible. Recognizing the eternal fitness of things, the anxious father immediately made a politician out of him. This may not be an inapt illustration of the way in which the career of many a youth is determined, and which would, of course, be less sensible than leaving the occupation to be chosen by the boy himself.

But time is passing, and we have said but little in regard to those in whose interest we specially desire to recommend the efforts of boards of agriculture, — the young men and women just entering upon the active duties of life. It is upon them and their associates that the welfare of New England will soon depend. The future of New England depends not upon her gifted orators, eminent scholars and cultured linguists, renowned and influential as they may be, but upon the skill, energy and acquired ability of the various industrial classes. Agriculture and manufactures form the base of our prosperity, and as the standard of these industries is raised or lowered so the standing of our New England, that we all love so well, is exalted or depressed. You have all noticed how those massive buildings in our cities are raised, how jack-screws are placed underneath, one after another, until perhaps a thousand are in place; then, the workmen turning each one around, the building begins to rise and finally is placed many feet in the air. This is a homely illustration of the work of advanced institutions. Our industrial colleges and boards of agriculture are engaged in advancing the greatest industrial interests of the land. A class is graduated this year, another next and another the year after. Its members go out into life's work, each prepared to do something for the welfare of his State and country in his chosen line. Each adds something to the resources of the country. Boards of agriculture hold meetings and institutes annually. The influence of each is uplifting, and by and by, like the massive building, we shall see the great interests of agriculture and manufactures, with all auxiliary interests, raised by the power of their efforts.

One of the gravest mistakes made in these days is that when a young man leaves school and college his education is *finished*. The boy leaves the grammar school at the age of fourteen with what he calls a finished education. The ambitious youth goes forth from the village academy with a finished education. The collegian is graduated from the university, sells his text-books to a freshman, piles up his acquirements in musty alcoves and begins life with a finished education. Perish the thought, — education is never finished.

Agassiz, holding in his hands the treasuries of an organic world, was a student to the day of his death. Sir William Jones and Elihu Burritt, the two men who learned so many languages, were students to the day of their departure to the great university above. Sir William Jones could speak eighteen languages and many dialects, and yet could keep silent in them all. "Yes," said Michael Angelo, at the age of ninety years, to a young man who had finished his education, whom he met on his way to the Coliseum, "*yes, I still go to learn.*"

While it is true that the science of agriculture in this country is still in its infancy, and men who have spent a life in its study have mastered a small part of it, yet even the few principles that have been taught will be of vast benefit to its students, and through their influence to all with whom they associate. The studies in plant growth will cause a deeper interest in the crops produced. Each period in the growth of a field of corn will be watched with more intelligence and be the cause of greater satisfaction, because of the knowledge of cause and effect. The study of the origin and composition of soils will lead to an enthusiastic appreciation of the wealth of nitrogen, phosphoric acid and potash stored up in the dirty acres of the old farm, and the best method of making it available for man's uses will be changed thereby from seeming drudgery to feelings of honor and respect. The knowledge that has been gained by the practical study of entomology will lead the young farmer to look upon bugs and creeping things of a destructive nature with little dread, for he knows their habits, and, with the scientific application of known remedies, he conducts his business with feelings of assurance, and is master of the situation. Those principles of stock feeding that are recognized authority the world over are made interesting and even attractive from the application given in farmers' institutes and agricultural educational institutions.

When we consider the intricate problem of drainage, and compare the former process with the recent developments whereby all surplus water is taken from soil with the least possible outlay of time and money, reducing the operation almost to the nicety of an art; when we for a moment reflect upon the marvellous developments that have been made in the study of forestry, and the vast financial returns that could accrue to the forest owners of the country from an intelligent and systematic harvesting of their forest products; when we call to mind the principles that have been established in regard to the sources of plant food and the various means of supplying needed fertility, coupled with the fact that a well-known experiment station recently states in a bulletin that the farmers of that State are annually paying $100,000 for worthless material in what are considered standard brands of fertilizers; when we consider the possibilities of irrigation in the development of agriculture and the knowledge already acquired in this branch of science; when we recognize the developments in veterinary science, and its bearing upon farming methods; when we consider that this enumeration could be almost indefinitely extended, having a bearing upon a thousand farm practices and forming the basis of the practical part of an agricultural education, and resulting in raising the business of farming from one of drudgery to an honorable and self-respecting occupation, — we are led to congratulate those who have become interested in this line, and to assure them that they are in one sense pioneers in what will later engross the mind and receive the attention of a much larger number than at present. It may be true that the science of agriculture has not been reduced to a pedagogical form, as some of our educators claim; but we are inclined to accept the opinion of the Boston teacher whom we have previously quoted, and assign as the reason the fact that those in charge of the educational affairs of the country have been more interested in conducting them in accordance with a literary standard.

There is something for the New England farmer to do if there is to be a change for the better. He must recognize the fact more than ever before that land must be manured with brains as well as chemicals, and that a scanty infusion of this compound is laid on New England soil, — truths which at a very heavy cost our community has begun to learn.

The *ideal farmer* is a widely accomplished man. Starting with a good general education, he has mastered the *practice* and *science* of farming; knows something of chemistry, geology, botany; of veterinary surgery, animal physiology, entomology; of mechanics, carpentry, smith work; of mensuration, levelling, land surveying; of farriery and forestry; of dairying, bees, fruit, poultry; finally, of accurate book-keeping. Often the New England farmer is strangely ignorant of these things. In many instances he pursues the methods of his fathers, covers his land with unsalable crops, refuses scornfully to make a change in accordance with the changed conditions, and meets a shrinking exchequer by economy in manures, feeding stuffs and labor, and despairingly continues an existence on an impoverished and weed-grown farm. This process has long been watched by the agricultural expert, and the only plausible means of relief is the applying of the educational preliminaries, accepted as essential to all other industries, to this, perhaps the most complex of all. In cereals we cannot rival perhaps the broad prairies of the West, but we can make a profit in producing those things demanded by the near market in fresh and palatable condition, if we have the advantage of adequate education. This may be sneered at by some as professional teaching or book farming; but, as a writer has well said, "Without this, in the future bankrupt farmers, pauper laborers, untilled soil and a deserted countryside will wait penally upon the antiquated process and the unskilled worker."

Boards of agriculture and managers of educational institutions can provide the means for an agricultural education, and to a certain extent create a demand for it and popularize it; but there is also a responsibility in this matter resting upon the New England farmers that cannot be borne by others.

We cannot allow this opportunity to pass without expressing what we believe to be a growing sentiment in favor of rural life; and yet as we travel over New England we notice many homesteads once occupied by those sturdy fathers and mothers of Puritanic descent, who were honorable men and women in every sense of the word, honest, industrious, temperate, self-reliant, patriotic, Christian people. They were the foundation from which have descended those sons and daughters who have built up our New England cities and developed the great West. Our hearts are filled with sadness as we notice many of these places occupied by strangers who are entirely wanting in the qualities which made the former class famous. They but poorly fill the places of those who went out from these rural districts to make a world-wide reputation for this great and glorious nation.

We believe some time in the future our New England boards of agriculture and agricultural colleges will rejuvenate New England agriculture. No occupation offers such pleasures as to cross the verdant fields in the morning and view growing crops, meander through the pasture lands and caress the noble animals that manifest intelligence and gratitude, wander through the thrifty orchard and stately forest, gather the birds around us and call them all by their names, — this is to live in the country and love the country, and make it not the home of the person only but of the soul. No occupation on the face of the earth begets feelings of a higher or holier nature or yields more supreme satisfaction. These thoughts apply with no little force to the gentler sex. The avenues of usefulness open to them are broadening every year. Whatever may attract them in the line of occupation, it should never be forgotten in their education that the home influence of a great nation is to be in their hands. The character of the home will have a greater influence in shaping the efforts of fathers, brothers and husbands for the welfare of all the people of this nation than some of the more radical measures suggested. Young ladies, above all things, should determine to shine with queenly grace in their home life, and exert an influence there that will be far-reaching and honorable.

It may be that our earnestness in advocating this practical education may leave an impression that we are not in sympathy with what is generally termed higher education. We desire to disclaim any such intention. The grand mental development and culture imparted after leaving the common school by a ten years' application to classical and professional studies are recognized and appreciated, and in certain cases are invaluable. The advocate of an industrial education should not be accused of antagonism to the other. We would have it well understood by the rising generation that there can be no less honor in contributing to the industrial prosperity of a country than in mere literary attainments. Boards of agriculture can help the farmers by advocating the advantages of this practical education and earnestly supporting the institutions where it is taught. It should be a prominent topic for discussion at farmers' meetings and institutes, for, however meritorious a measure may be, it requires constant agitation to secure its adoption.

Doubtless you have all heard of that worthy son of Erin's Isle, who was sending a valuable package by express, and, following out the custom much in vogue, he stamped in bold type, "This side up with care." Fearing that this important injunction would not come to the attention of the hustling expressman unless more prominently displayed, he emphasized by repeating it, and sent the package upon its journey after plainly marking on each of its six sides, "This side up with care." We would have such earnestness manifested in this subject of practical education and such demand for it that advocating the advantages of practical education in agriculture shall be printed in bold type at the head of the list of duties assigned to boards of agriculture; then we would have this list prominently displayed in every school-room, in every academy, in every grange hall, in every other place in the land where people assemble for educational purposes; and when securely placed we would print in flaming type the inscription of our Irish friend, "This side up with care," and thus hasten the good time coming when the agricultural people of this nation shall appreciate practical instruction for the elevation of the great fundamental industry, — American agriculture.

And then we would teach the farmers of this country the advantages of agricultural education by manifesting, in their homes, on their farms, in their market places and wherever we meet them, such absolute confidence in its utility and its advantages for their children over a literary education simply, that they would be made to realize the honor and dignity of the true husbandman, and all together, the farmers, boards of agriculture and the managers of agricultural schools, we would fight valiantly for restoring in some degree the integrity of mind and heart among our rural population; and when that shall have been accomplished we shall have in our New England country homes the foundation for ideal country life.

The Chairman. There will now be an opportunity for discussion, but first I wish to call upon our old friend Dr. Geo. M. Twitchell, secretary of the Maine State Agricultural Society, who no doubt has a message for us, and I know we shall all be glad to hear from him.

Dr. TWITCHELL. Years ago in a town in the State of Maine there was a family every member of which was determined to have a college education. The father died, and the mother struggled on, and son after son grew to years of maturity; a mortgage was placed on the farm, until finally the last son was ready to enter college. No one of them as they graduated had been able to make any practical use of the education received, but it was still in the mind of all that they must go through college. The mother finally went to a friend for assistance, and he was talking about it in a store afterwards, and in that store there chanced to be a good old farmer who was full of what you would call "horse sense." He listened awhile and then said, "Well, I tell you, I don't see any sense in so much edication without any larnin'." It seems to me that we must seek to combine the two in this work of our boards of agriculture; that the thought of education must be uppermost, as it was so well stated by the speaker, and we surely must endorse every word he has spoken this afternoon. The distinction seems to be made that there is a high and a low education. There is no low education. Education along the line of what we would call "the practical" is high and helpful, and will always be of service in the world. How is this Board, and the other boards of agriculture in New England, to be of service — the greatest service — to the farmer? It seems to me that there are one or two ways we might mention to which particular stress has not been given, but which were covered in the admirable paper we have just listened to. I have found, in what little experience I have had with our boards of agriculture, that the best success has been secured when the institutes were held in strictly farming sections. That does not hold with these winter meetings, where we seek to accomplish specific results. I am thinking, friends, that the man out there is the one we want to reach. You who have studied these questions all these years and become familiar with agricultural sciences have gotten them well grounded in your being. But there is a man down yonder, a young man who is struggling, a young man who has a home to enrich in the years to come, and who desires to grow in every essential; and how are we to help him unless we go out and meet with him and his neighbors, not in the towns and cities? You cannot call the farmers into towns and cities for these institutes, for naturally they feel that they are there overshadowed. We have had and shall have the best results as we attempt to reach out to those who need the inspiration most, — and these men are on the farms. This is one way in which this Board of Agriculture and other boards of agriculture can be of more service to the farmers in the future than perhaps they have been in the past.

Brother Bachelder impressed the importance of dealing with facts as well as theories. An old lady went to a doctor and said, "I want you to tell me, if you can, why it is that some people are born dumb. Can you tell me?" "Certainly," he said. "Why is it?" The doctor said, "Some people are born dumb because they haven't the faculty of speech." The lady replied, "What a blessed thing it is to have a medical education. I have asked my husband that question a hundred times, and he simply said, 'Because they are.'" Some things are, and we cannot change them; but we want to know why they are, if possible. It is not enough to know that harvest follows seed-time, that cultivation produces better germination; we want to know why. I sometimes am overwhelmed as I think of this question, and realize how the man who is out on the farm is dealing all the while with the very mysteries of God. Results follow certain acts, this much we know; but the why and how belong largely to the realm of theory. With results we are not to be content, but seek for something greater and better; and the institutes come in to serve as a stimulant and strengthener for better knowledge and sharper practices. More of fact, more of experience, more of assistance, as well as more complete harmony between theory and practice, is the cry going up from the earnest workers who crave the benefits of the institutes. The lessons of the hour are pregnant with significance to every man who thinks and probes. More of product, better quality, reduced cost of production,—these are the need everywhere, and to assist in comprehending the conditions which govern is the duty of every speaker at every institute. Speakers must keep close touch with what is legitimately practical, every-day topics and standards, if they are to aid in extending the scope of the institutes. There is no occupation in the world where man cannot be master of the situation, because he may control all the events which enter in. The boys do not stay on the farm, because we have not shown them the possibility of the farm. This is the work of the boards of agriculture, — to inspire them, and prove, as we may, the possibilities for the largest, truest, deepest manhood upon our New England farms. There is no other opportunity offered in the country for a better development of manhood than can be found here.

Again, we have become familiar with the composition of our fertilizers, with fungi and fungicides, insects and insecticides, and the different forms of bacteria that are all about us, and the terms roll off our tongues easily, and we know what we are talking about. Does that young man understand and appreciate? How many men, busy all the week with the manifold duties of the farm, skilled in regular lines of work, using fertilizers freely, seeking to destroy the pests in field, orchard or barn, have the time to give to a close study of terms and the strict meaning of scientific names? Keen and bright in intellect, the line of study has been along the how and why, rather than to become familiar with scientific terms and phrases. The man who uses these terms may not be as intelligent as the man who is after information, but who sometimes loses the thought in the effort to get the exact meaning of the word. Is there not a demand for what may properly be denominated the practical, divested of heavy-laden scientific terms? The sole purpose of the institute is to assist; and plain, simple language will always lend power and force to the thought of any speaker. The man who waits to grasp the full meaning of a word or term loses the significance of a sentence. This does not indicate any dropping of the standard of thought or method of instruction, but simply the putting of things in a pleasing and interesting manner, without which there can be no influence.

I sometimes think that the multiplication of farm machinery is a positive injury to the farmers of New England. A man said to me the other day that he had never harvested his acres of corn so easily as this year. He paid a man two dollars an acre to cut the corn and tie it up ready for stooking. Could he earn that two dollars easier some other way than he could cutting it himself? If not, the bringing in of improved machinery is becoming a further burden. These machines not only lift heavy burdens from the back and hands, but they also do the work with greater rapidity. If, as we get relief in one direction, the machine is used to swell the output, then, in enlarged operations, there will be profit. Not in restricted but extended work are they to be found profitable. Here is a work for the board of agriculture in its institute work.

One thing more: it is the importance of enforcing the lesson that growing and producing the best of which the man and farm are capable is only one-half the story, that the selling has as much to do with success as growing; and the work of the board of agriculture is not completed until it has assisted the farmer to help himself to a full knowledge of markets and demands and the best means and methods of putting the product thereon.

Here are some simple lines of work. You have gained the inspiration of these larger gatherings. You are going back to your homes to hold the institutes which are required by law. Are they to be better than last winter? Are they to be of more service? Are you to call in a larger number than ever before? It is the doing of some service which is necessary. How this question comes upon us, as we realize the demands of the day, the competition which forces itself upon our attention. What necessity there is that we should use these agencies in order that we may make our organization more effective and helpful. What is to be the future of the New England farms? Are the boys from your families to be the men who will till the soil, or are we to be dependent upon a foreign population? I have here indicated some of the lines which it seems to me we may carry forward, and make more effective the work we desire to do by and through the institutes held the coming months.

Mr. F. H. Appleton of Peabody was called to the chair, and upon taking the chair said: It seems to me that we should take advantage of every opportunity to distribute information for the benefit of our agriculture. I wish the experiment station at Amherst could be taken up and carried about as an object lesson, and that Dr. Goessmann could accompany it to explain and enforce the lesson. Every one who has visited the station realizes the advantage of having him explain the different methods of fertilization and the value of different crops for special purposes. He has experimented in these directions, and recommends that we try on our farms certain methods and crops, believing that we will find them useful and valuable in our farming. As members of the Board of Agriculture, we should spread abroad these ideas and advocate them throughout the State. Our institutes provide opportunities for this work, and our instructors and experimenters are ready to assist by lectures and discussions at these meetings. The list of speakers and subjects prepared by our secretary contains material on most subjects of interest to Massachusetts farmers, and the agricultural societies can select from it lecturers for their institutes, and have such subjects discussed as may be most useful and interesting for the farmers in their localities.

It has always seemed to me, as the lecturer has so admirably shown us, that agriculture might be incorporated into the course of instruction in our common schools. The mind may be trained by the study of agricultural subjects as well as in any other way. I remember bringing home from England some little books that were used there in the elementary study of agriculture. They were much on the plan of our Sunday-school books, — the question and then the answer. It seems to me that we might well have in our schools various lines of work, such as entomology, chemistry, botany, horticulture, etc., which would be valuable in disciplining the mind and would also be of much advantage in the pursuit of agriculture.

Mr. C. B. Lyman (of Southampton). I believe it is a great mistake that our boys and girls have nothing in their common-school course upon subjects pertaining to agriculture. I think it would be of great advantage to the children in our schools if there were text books in use which treated upon the growth of fruit and fruit trees, plants of all kinds and the crops we raise. These books would be interesting as well as useful, and would serve to stimulate a habit of observation in the pupils as they are brought into contact with the works of nature. If the young people had such a course of training in school, I think more of them would choose to live in the country.

Hon. T. S. Gold (secretary of the Connecticut State Board of Agriculture). The remarks of Mr. Appleton in regard to those little books that he saw in England reminded me of Johnston's "Catechism of Agriculture," a book that was published some fifty years ago in England, edited by Professor Norton of Yale College. This little book contained these questions: "What is agriculture? Agriculture is the art of cultivating soil. What is it necessary for the farmer to know? He should know the nature of the soil he has to deal with, the nature of his crops and the character of the animals." That little handbook of a hundred pages was one that I used in teaching for nearly twenty-five years, and found it a mine of wealth to develop the character of boys in the school. Day by day I could bring some object lesson before them from the farm or garden in connection with that book, and the dullest boys would find something there that they would catch hold of, and become quite average scholars. Now, that is only a small point to make here, but it is certainly a very important one. Haven't we gone back a little in our school books and the early instructions that we got in our schools? Are we not now suffering from the fact that our books are almost all from the city and village stand-point, and not from the stand-point of the farmers, as we remember them to be? I always want to say a word for old Webster's spelling book whenever I have an opportunity; and I rejoiced when I was at the Centennial at Philadelphia to see that pyramid of spelling books, weighing tons, in which it was stated that the number of Webster's spelling books at that time annually circulated was represented in that pyramid. I do not remember anything that I saw there that pleased me as much as Webster's spelling book. In it were simple stories coming right from the farm. Where can you get so much practical knowledge as you found there? These stories would attract the boys to study and to read. When I see the papers ridiculing the idea that the reading books of to-day for children have so much to say about the cat and the dog and the pig, I think those who hold that idea up to ridicule do not know the first elements of human nature. These animals are the most attractive objects to childhood. Let us encourage as much as possible this kind of instruction in the schools and for family reading. What a store of knowledge and wisdom there is in Æsop's "Fables" for the country boy or girl or any other boy or girl.

There was one remark made in regard to the duties of the boards of agriculture that reminded me of an expression used by the Rev. Dr. Bushnell of Hartford some forty years ago. He originated the idea of that beautiful park in the centre of the city of Hartford, — that is the kind of a man he was. While he was preaching the gospel, he had an eye to material prosperity. He said: "The question now comes before us, whether, instead of sitting here and considering the wants of the people, we had not better form ourselves into a board of agriculture, and see what can be done for these towns that are becoming somewhat deserted of their population." It was some forty years ago that he gave expression to these ideas. Our boards of agriculture want to draw in just as much as possible just that sort of men, whether they are on the farm or in the pulpit or at the bar.

Hon. Jas. S. Grinnell (of Greenfield). Do any of the members of this Board of Agriculture know that a book was prepared on the elements of agriculture, read, corrected, endorsed and published with the sanction of the Board of Agriculture? It was used, I do not know for how long. We went over it three or four times and corrected it, and it was one of the standard books for agricultural education. It consisted of questions and answers of a simple, intelligent kind, and was adapted for use in schools. It must have been somewhere in the early fifties that it was published.*

Mr. J. H. Hale (of South Glastonbury, Conn.). Mr. Chairman, members of the Board and friends: I certainly am glad to be here, and was particularly interested in the thoughtful and worthy address of the secretary of the New Hampshire Board of Agriculture. I think he dropped very many thoughts that should be acceptable to this Board and all boards of agriculture in this country. It seemed to me, when he was talking of the various things that boards might accomplish, he mapped out a pretty broad programme, that there was more than would be likely to be accomplished in a lifetime, but it was in the right line. The institutes, it seems to me, are carrying the gospel of progressive agriculture into the hearts and homes of the people that need it most. The institute work needs to develop and broaden out. It is all very well to plan an institute and secure one or more speakers on practical topics and send them to a community; but the institutes are not thoroughly advertised and the people are not called out, and the speaker talks to the benches, or to the people who are already awake and who need it least. It seems to me that there is a great need of a rising interest in these institutes. I was particularly interested in the matter of carrying agriculture into our public schools, and I was even more interested when our worthy chairman said that the mind can be trained just as well from the study of agriculture or horticulture as in any other line. If you do nothing else for a year, you have done a good work. The lecturer has been for years the secretary of the Board of Agriculture in New Hampshire, and has been closely connected with the grange, and he speaks from experience. I believe that the important thing is to show the advantages of our business, not wholly from a commercial stand-point, but from the point of making stronger and better men, and that there is a better side to agriculture than mere drudgery. I believe we should do that which we enjoy, and then we shall have the greatest success. We shall be broader and better men. There is much in the different branches that is enjoyable, and it is the purpose and the privilege of the boards of agriculture to develop these things. It seems to me that is one of the missions of the Board. The inspiration that came to me from an address given us by a lady, on "Farmers, open your eyes," has been more valuable to me than any other one thing that I ever got out of any board of agriculture, and I have attended the meetings of boards of agriculture from my boyhood days, when I had to borrow money to get there. It was money well invested. I am glad to hear such inspiring talks as Brother Bachelder has given us, and the cheering words from our chairman.

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* Soon after the State Board of Agriculture was incorporated, in 1852, a committee was appointed to consider the expediency of preparing a manual on agriculture for the use of common schools, and in 1856 a similar vote was passed; but no definite action was taken until, in 1860, the Board "*Resolved*, That the committee on agricultural education be authorized to prepare an elementary manual of agriculture for the use of our common schools," and do what was possible to secure its introduction. This resulted in the preparation of a manual by the secretary of the Board, Mr. Chas. L. Flint, and Mr. Geo. B. Emerson (author of report on the trees and shrubs of Massachusetts), which was read to the Board by Mr. Emerson. An agreement for publishing the same was made, and Jan. 25, 1861, the Board "*Resolved*, That this Board approve of the 'Manual of Agriculture,' submitted by its authors, Messrs. Geo. B. Emerson and Charles L. Flint, and recommend its publication by those gentlemen as a work well adapted for use in the schools of Massachusetts."

Mr. GEO. M. WHITAKER (of Boston). Mr. Chairman and gentlemen: I want to call attention to one thing that I think has been overlooked. I agree with everything that has been said in regard to the importance of studying agriculture in the public schools, but I am a little sorry that it has taken the form of criticism of our educators. I believe that the best educators of to-day believe in the importance of science studies, and are practising their beliefs so far as they have money to do so. In order to teach these sciences, we must have competent teachers. Our country towns, with diminishing population and increasing taxation, are finding it hard to support the public schools, even as at present conducted; and one practical question it seems to me in connection with the work of the boards of agriculture is: How shall we aid the country towns so that they may have money enough to employ competent teachers to carry out the ideas of the secretary of the State Board of Education and the best educators in relation to teaching science in the common schools?

Mr. W. A. KILBOURN (of South Lancaster). I think that the advice given by some one that we are to "open our eyes" is perhaps the best. We do not do it sufficiently, in any sense of the word. In reference to our schools, they are taxed pretty heavily, both in the time and the immense number of subjects that they are expected to teach; but I believe most fully that our education goes on after the time of school days, and the important thing is to keep our eyes open, to make our observations and to take advantage of them. A single illustration of this may not be out of place. In a recent visit to the exposition at Atlanta I went into a building which was called the *plant system.* It was filled with plants, and appeared to be an exhibit of agricultural and horticultural products, and the name seemed very appropriate. But on further observation it proved to be the plant system of railroads, which had adopted this manner of exhibiting the products which were raised over the country where their system of railway extended; and farther along was a railroad track with cars and engine upon it, on a small scale, which I supposed was some narrow-gauge thing, but on examination it proved to be a train of half size, and upon which was loaded various products, and on these products was indicated the number of tons and carloads of these different articles that their system had carried by freight during the past year. That began to open my eyes a great deal more. Looking still farther, I passed along by a nice cocoanut tree. The gentleman who seemed to be in charge of the exhibit was explaining the matter to me, and finally called my attention to the cocoanuts growing. He showed me the three places in the nut which I used to think were made to get out the milk. But he explained to me that when the cocoanut was planted the sprouts made their way through these soft openings, and the nourishment they drew from the milk enabled the bud inside to press open the hard shell. It explained those three simple openings, and they are for a very wonderful purpose. So I think in the apple, when we hold up a section toward the light and see the blossom in looking through it, it explains a wonderful connection between the fruit and the bud. These observations which can be brought to the mind of everybody are of great use and value in developing the thought of every one. Wonderful facts are to be found by increasing the observing powers, and in that line is to be found the secret of all education. How to develop it, where to make the most practical application, is a question for each and all of us to answer.

Dr. C. A. GOESSMANN (of Amherst). In regard to the mode of teaching the first principles in the elementary schools, to teach them effectively requires a thorough education in the first principles. The kindergarten is the best illustration of elementary teaching. I think that in our system of teaching at the present time we assume too much; our instructions are not elementary enough. To teach in an elementary way is to acquire a most thorough education. I myself believe that agriculture should be taught in the elementary schools and so brought up to the colleges. The time is too short to bring all the details up.

Adjourned.

On the evening of the first day a reception was tendered the Board of Agriculture in the town hall by the citizens of Dalton. A banquet was provided, and there were speeches by His Excellency and others, singing by the Oberon Ladies' Quartette and instrumental music by the Dalton brass band. The occasion was a very enjoyable one.

SECOND DAY.

The meeting was called to order at 9.45 A.M., Mr. E. W. WOOD of West Newton in the chair.

After the singing of several songs by the Oberon Ladies' Quartette, the chairman said: Your committee have selected a subject in which not only the farmers but the people of the State generally have as deep an interest as in any subject that can come before this Board, and they have provided a speaker who has had much experience in looking after the dairy interests of the State. The subject is "The milk supply of Massachusetts cities," and I have the pleasure of introducing as the speaker Mr. GEO. M. WHITAKER of Boston, assistant executive officer of the Massachusetts Dairy Bureau.

THE MILK SUPPLY OF MASSACHUSETTS CITIES.

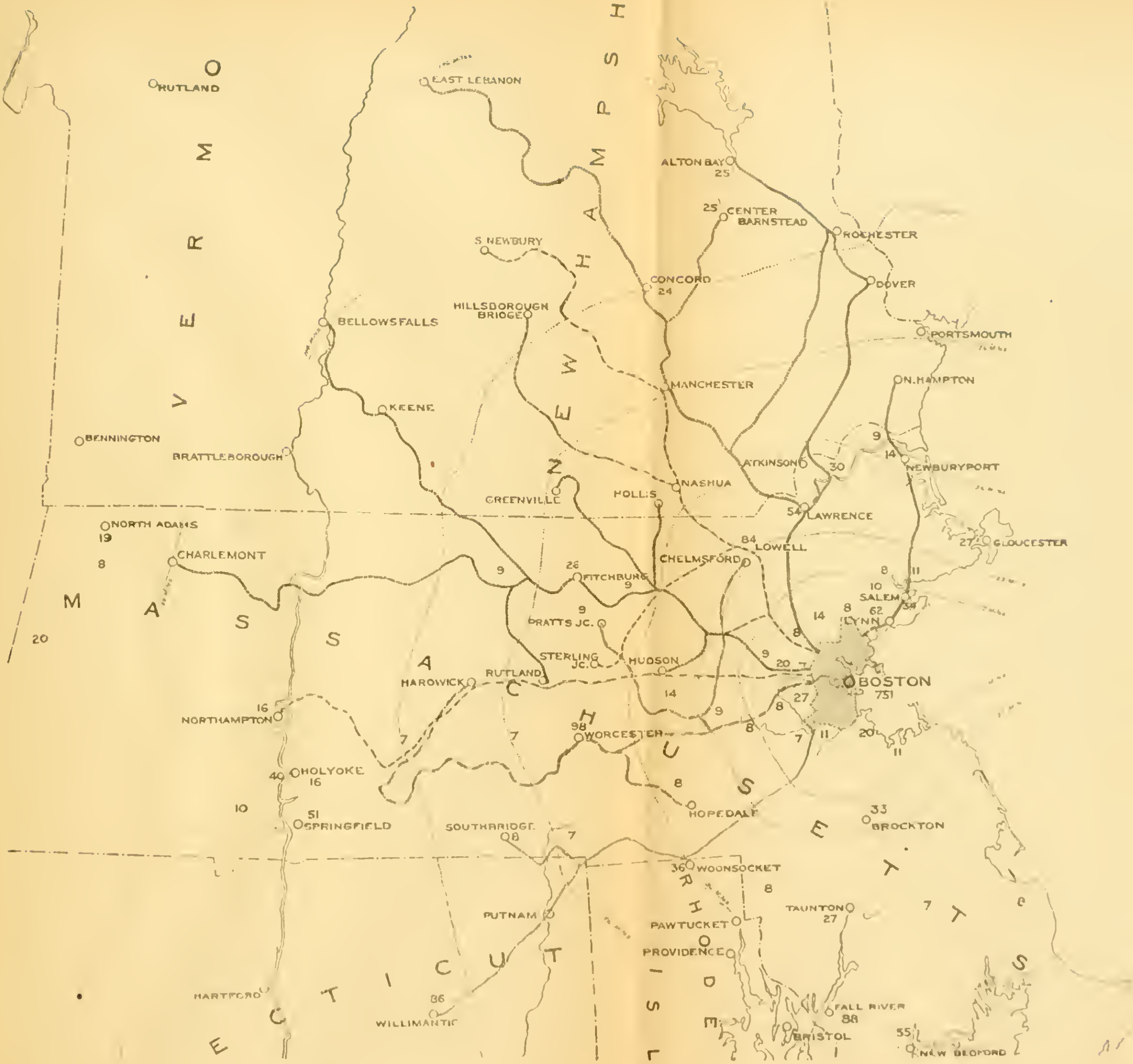
BY GEO. M. WHITAKER OF BOSTON.

Statistics of butter and cheese are abundant. The production, the exports, the amount in storage, the consumption, are matters of comparatively accurate record, which are systematically compiled and carefully preserved. In Massachusetts the production of milk for sale is a more important branch of dairying than butter or cheese making, yet of this we have had no reliable statistics; and, while creamery or butter literature abounds in the agricultural press and experiment station bulletins, comparatively little is written about sale milk.

One reason for this is found in the perishable nature of milk. It must be in the hands of the consumer as soon as possible after it is produced. There is no opportunity to hold the supplies; we never see cans of milk on Market Street waiting a purchaser, and there is no possibility of a surplus being left over to go in cold storage for next week or next month. Milk is almost continually on the move from the cow to the consumer.

Except in the case of the largest cities, the supply comes in small lots from territory within a few hours' drive from the place of consumption, and is for the most part delivered by the producer. The stream arises from so many small springs, and is so soon out of sight, that accurate information as to its magnitude is difficult to obtain and has never been compiled. In the absence of such data, the industry has not attracted the attention it deserves.

The sale milk business is a particularly interesting study in a State like Massachusetts, because a large proportion of the population lives in cities and large towns. At the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ROCHESTER
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HARTFORD
86 WILLIMANTIC
FALL RIVER 88
BRISTOL
55 NEW BEDFORD

eastern end of the State is the "greater Boston," with three-quarters of a million of people, situated upon the sea-board, so that their milk supply can come from only three directions. A circuit of towns and cities with a population of 149,000 encompasses the "greater Boston." Hence we find 800,000 people thickly settled in a comparatively small area. The force of this will be realized more from the fact that the centre of the State, as regards population, is within half a dozen miles of the shores of Massachusetts Bay.

Aside from the "greater Boston," Massachusetts has 32 cities and towns of over 10,000 population. These aggregate nearly 1,000,000 people. Counting the "greater Boston" as one, 33 cities and towns of over 10,000 population have 1,716,424 people. Nineteen towns of the State have over 7,000 population and less than 10,000, and aggregate 157,649 inhabitants. Adding this to the above, we find that 52 cities and towns of 7,000 population and above have 1,874,000 persons, or, in round figures, 1¾ millions. This is 75 per cent of the whole population. Most of these people are so situated that they must receive daily calls from a milkman, who has bought his milk at some railroad station or driven several miles from the farm to distribute it.

This is a conservative basis for any calculation, because many people in towns of less than 7,000 population cannot depend entirely upon home resources for their milk supply.

The amount and distribution of the city population of the State is illustrated by the accompanying map, the figure upon the location of the different cities and large towns indicating the number of thousand of population of each place.

Milk Consumption.

If 1,870,000 people use each half a pint of milk daily (and that is a moderate estimate), the daily consumption is 467,500 quarts; and if the milk nets the farmer 2½ cents a quart, the business aggregates $11,687 per day, or annually $4,265,755. If consumers pay an average of 7 cents per quart for milk, they pay $32,725 per day, or $12,000,000 per year.

The milk inspector of the city of Lowell estimates that in his city the consumption of milk amounts to $6.77 per capita per year. On that basis, for the population stated above the total expenditure would be $12,660,000, or $660,000 more than my figures. At an average of eight quarts per day the supply indicated above would require 60,000 cows.

Is not such a business deserving the careful attention of the State Board of Agriculture? When we consider the amount of capital required to carry it on, in the farm, the cows and the fodder, — raised or purchased, — and when we also consider the necessary investment for the distribution of the milk, we see that the sale milk business is a very important agricultural interest of the State. But when we also recall how generally this article of food is used, its value in the dietary of both sick and well, of both infants and adults, our realization of the importance of the industry increases. And the State Board of Agriculture, standing, as it does, at the head of Massachusetts farm interests, should make the sale milk business a prominent department of its work.

The amount of milk that is sold in the towns and cities of the State can in some instances be ascertained by more accurate statistics than the above approximation. The Boston wholesale dealers who supply the "greater Boston" have for several years had an understanding with each other, by which their accounts are compiled at the end of each month, and furnished to the Milk Producers' Union. The table accompanying this gives the receipts and sales for the year 1895, in 8½-quart cans: —

MONTHS.	Received.	Sold.	Surplus.
January, ...	801,457	621,049	180,408
February, ...	730,937	563,039	167,898
March, ...	860,757	631,527	229,230
April, ...	861,524	656,943	204,581

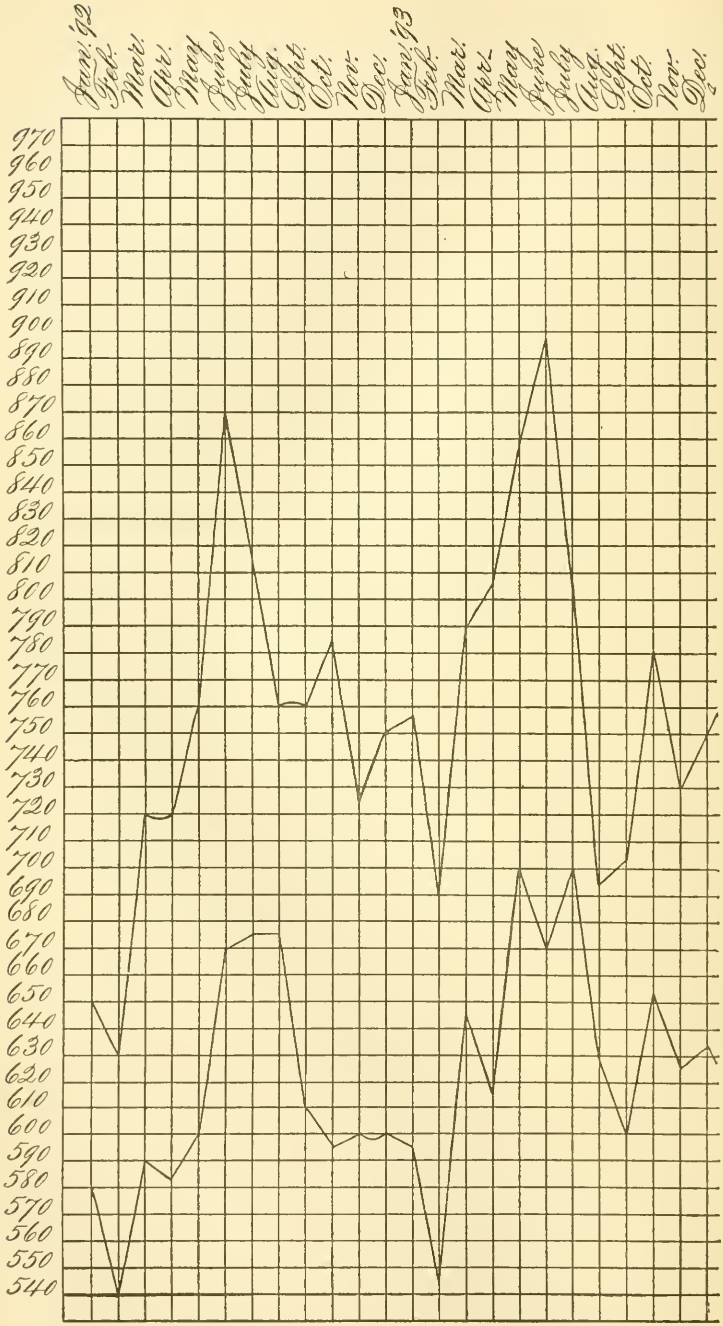
MONTHS.	Received.	Sold.	Surplus.
May, ...	934,871	710,823	224,048
June, ...	918,079	704,364	213,715
July, ...	801,285	721,618	79,667
August, ...	771,628	701,149	70,479
September, ...	758,131	699,140	58,991
October, ...	820,454	679,128	141,326
November, ...	782,071	687,530	94,541
December, ...	815,306	664,422	150,884
Totals, ...	9,856,500	8,040,732	1,815,768

The receipts and sales for five years are as follows : —

YEARS.	Received.	Sold.	Surplus.
1891, ...	7,281,524	6,113,803	1,167,721
1892, ...	9,212,667	7,315,135	1,897,532
1893, ...	9,263,487	7,619,722	1,643,765
1894, ...	9,705,447	7,657,421	2,048,026
1895, ...	9,856,500	8,040,732	1,815,768

The receipts and sales by months for the past four years are graphically illustrated on pages 52 and 53. The figures at the left indicate the number of thousand cans.

During the year 1895 the milk sales by the large wholesalers in the "greater Boston" ranged from 165,000 to 195,000 quarts per day, the average being about 180,000 quarts per day. The Boston milk inspector estimates that 34,000 additional quarts are brought into the city from near-by territory. The Cambridge milk inspector estimates that nine-tenths of the supply of that city is furnished by the Boston wholesalers, the remainder coming from outside towns in the vicinity; in Somerville and Chelsea the figures would probably be about the same, which may be estimated for the three places at 26,000 quarts. This makes the consumption of milk in the "greater Boston" 240,000 quarts daily, con-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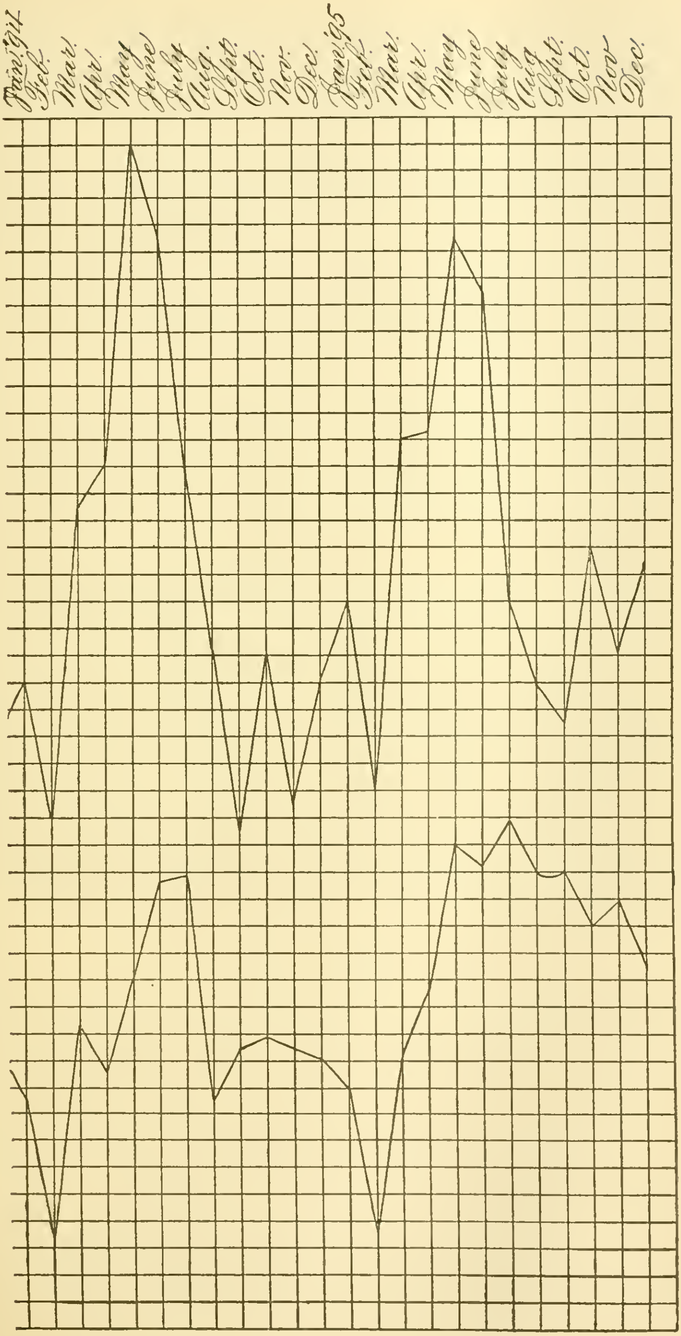
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siderably above my estimate, which is thus proved to be within safe limits. In 1872 the State Board of Health estimated the Boston supply at 96,000 quarts (1873 report, page 299). Returns from milk inspectors and others in some of the other cities and towns report the daily consumption as follows: Holyoke, 12,000 quarts; Worcester, 42,500 quarts; Haverhill, 8,500 quarts; Lynn, 12,750 quarts; Lowell, 30,000 quarts; Spencer, 1,550 quarts; Hyde Park, 4,250 quarts. The Springfield Milk Association last year received 2,746,574 quarts. The Pittsfield supply, as computed from the milk inspector's books, is 5,200 quarts daily; this, at the average price of 5½ cents, would amount to about $3,000 per day, or $104,000 per year; of this sum $7,300 comes into Dalton. By estimation, 6/7 of the Pittsfield supply is retailed by the producers, and 1/7 is handled by middle-men, who pay 2½ cents per quart in the summer and 3½ cents in the winter.

Many milk inspectors do not require any statement from peddlers who secure licenses, as to an approximate of their business, and can give no figures with any degree of accuracy. A very few paid no attention to my request for information.

Outside of Boston all the towns and cities receive their milk supply from teams driven to town every morning, with two exceptions, — Lynn has two carloads a day and Lowell has one carload a day, both from New Hampshire. Most of the Boston supply is from the cars, and the method of handling it deserves especial consideration by itself.

Boston Milk Supply.

Four large firms control practically all of the wholesaling of milk and most of the car milk in the "greater Boston." The routes over which their milk cars run and the places from which they start are indicated on the accompanying map. In most cases the milk is loaded at stations comparatively near the place from which the car starts. The milk is bought and handled in 8½-quart cans furnished by the contractors. It is forwarded to Boston in cars that can be refrigerated in summer and warmed in winter. These contractors have sheds, platforms and depots in Boston, at which the milk is received. The trains arrive as a rule during the forenoon, chiefly between ten and twelve o'clock, regardless of the distance they have run. The milk is loaded on the cars the same morning that it arrives in Boston, but is usually the milk of the evening and morning previous, though some places are so situated that the morning's milk is shipped on the day of production. On arrival the milk is taken from the car or platform by peddlers, and most of it is carried to their milk-houses, where it is run through a mixer, put in quart and pint individual cans, and stored on ice until the next morning, when it is delivered. Thus the milk of Monday morning and Monday night — sometimes of Tuesday morning — is put on the car Tuesday morning, reaches Boston about noon, is kept on ice at the peddlers' places of business Tuesday afternoon and night, and is delivered Wednesday morning, twenty-four to forty-eight hours old before it reaches the consumers.

One peculiarity of the way in which the Boston milk business is done is that it gives steadiness to the market and prevents any excessive supplies from breaking the price. It therefore has advantages, though it causes complaint among some producers. The contractors, instead of operating like wholesalers in other lines of business, who buy what they think their trade will take, contract six months in advance for all the milk their farmers will bring to the cars. They agree to pay the stipulated price for what they can sell, and for an addition of five or ten per cent carried for their convenience to meet the varying demands of trade. The surplus above these amounts is made into butter, and the farmers are paid for the surplus milk what the butter is worth, less the cost of manufacture. The motive for buying in this way — usually more than can be sold as milk — is to control the supply as far as possible and keep competing milk off the market; as the contractors hold back the milk they cannot sell, they prevent a glut and any weakening of prices. The contractors claim that this also helps many farmers, who prefer to sell all the milk they can make, even if they get less for it.

The contractors, for ease in computing the amount to be paid for the surplus, reduce it to a percentage of the whole, and make a proportionate discount from the farmers' bills; hence it is popularly known in the language of the trade as the "charge-back," though this is an incorrect use of language. The account properly stated would be: —

—— cans at —— cents (the sale milk price),	$
—— cans surplus at —— cents (the amount realized from butter less 4 cents per pound for making),	
Total,	$

The amount of money the farmers receive would be the same in either case; the latter system of accounting would remove the unpleasant allusion to a discount. As there is more or less popular mystery connected with the amount of the surplus, and as there is a natural repugnance at having a bill discounted, many farmers are much dissatisfied at this surplus discount or "charge-back."

The price to be paid by the contractors for what they can sell and five or ten per cent more is adjusted by a committee of the contractors and of the producers, each March and September, for six months from the first of April and the first of October.

The milk is bought delivered at the local railroad station, the contractors transporting it and caring for it in transit. This is different from the custom prevailing in some other States, where milk is bought delivered at the city railroad station, the farmer paying the freight.

As milk is taken from many railroad stations at different distances from Boston, to fix a price for each station would be a long and tedious task, unless the New York custom of a uniform price for all distances were adopted.

Here a series of lines has been drawn about the city, and a series of discounts from a theoretical Boston price has been agreed upon. All negotiations relative to price relate to this theoretical figure, and when that is determined, each farmer can apply the discount for his own station, to ascertain the price he is to receive.

On the accompanying map I have drawn the lines for the purpose of illustrating this discount. The first line is 17 miles from the city, as measured on the lines of transportation. Nearly all the milk which comes to Boston within this circuit is brought in by teams, but what little milk the contractors buy in this territory they buy at a discount of 7 cents from the Boston price. The next line is 23 miles from the city, and between the 17 and 23 mile circuit the discount is 8 cents. The next line is 36 miles from the city, and in the belt included between the 23 and 36 mile circuit the discount is 9 cents from the Boston price. The next line is the 56 mile circuit, and the price in the belt between 36 and 56 miles is 10 cents discount from the Boston price; between 56 and 76 miles the discount is 11 cents; from 76 to 96 miles the discount is 12 cents, and beyond that 13 cents, though the distances over which the cars run are now growing so great that before long there may have to be another discount.

The theoretical price in Boston this winter is 37 cents per can, so that within 17 miles of the city the price at the railroad station is 30 cents per can; from 17 to 23 miles, 29 cents; from 23 to 36 miles, 28 cents; from 36 to 56 miles, 27 cents; from 56 to 76 miles, 26 cents; from 76 to 96 miles, 25 cents, and beyond that, 24 cents. The contractors sell the milk to peddlers at 2 and 3 cents less than the Boston price.

The "discount" for surplus varies from month to month, but generally speaking it amounts to about a cent or less a can. This year it will be less.

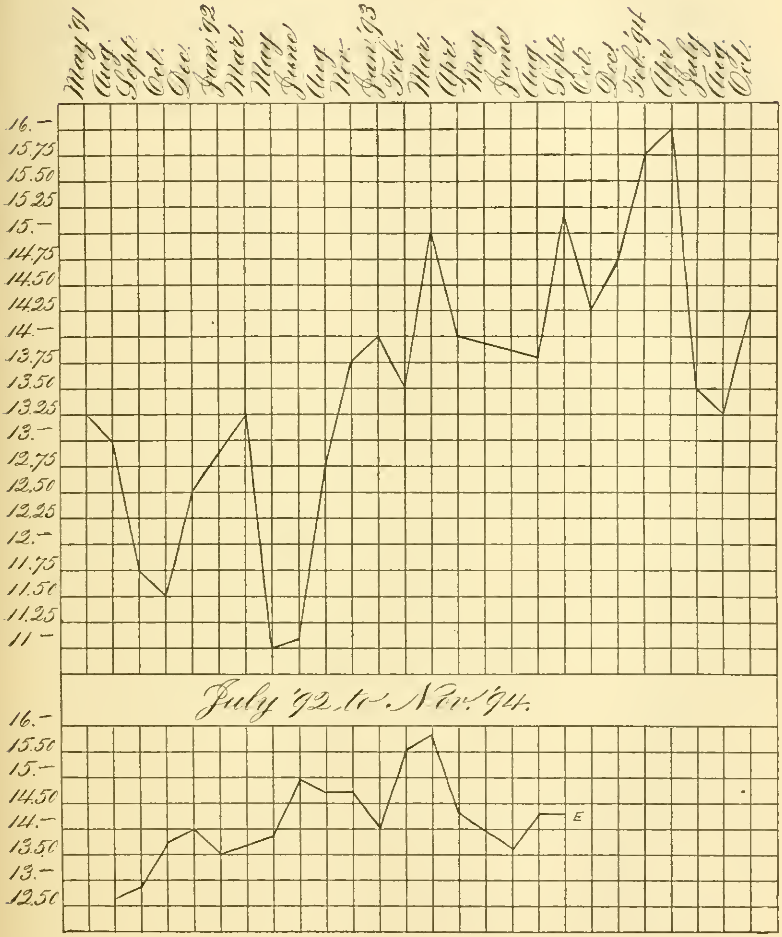
In some cases the farmers co-operate in getting the milk from the farm to the railroad, paying some one of their number to carry it, and the prevailing price is about 2 cents per can. Hence, on the basis of 37 cents as the theoretical price, this winter the farmers nominally net at the station 24 to 29 cents per can; if the surplus deduction averages 1 cent, they actually net from 23 to 28 cents; and if they pay 2 cents for teaming to the depot, 21 to 26 cents per can is left for the farmer at the door. For several years the summer price has been 3 cents less than the winter price, or 18 to 23 cents at the farmer's door, with the above assumption as to surplus and teaming. These prices have been well maintained without much change for several years.

The report of the Board of Health for 1873 contains the following: "The price per can at the farmer's door has been for the past few years from 33 to 42 cents in summer and about 45 cents in winter; the price obtained by contractors, 40 to 48 cents in summer and 50 cents in winter."

A Concord correspondent of the "New England Farmer," in September, 1852, complains of the price of railroad milk for Boston, which he states at 2⅛ cents per quart in summer and 2¾ cents per quart in winter.

Another peculiarity of the Boston milk system is what is called grading the price. If the Dalton farmers, for instance, were entitled to receive 25 cents per can for milk for the six months from April to October, the contractors might pay 27 cents for April and May, 23 cents for June and July and 25 cents for August and September, so that the average for the six months would be the price agreed; but less than the average would be paid during the months of the most plenteous production. One of the grievances of the contractors, from their side of the case, is that the farmers produce milk in uneven quantities, flooding them with an unsalable surplus one month and leaving them short another, and the price is "graded" on this account. The surplus this year has ranged from 59,000 cans in September to 229,000 cans in March, and is graphically seen on the engraving (see page 52). One firm of contractors, in order to lessen the trouble of unequal production, has ascertained from the records of its business which farmers produce the most uniform quantity of milk the year around, and is paying them the regular price without any deduction for surplus.

This is a just transaction, as under the other plan all the contractors reported their receipts and sales to their organization, and the surplus was averaged over the whole territory. Hence, the farmer who took pains to have cows come in at all seasons of the year, and to produce a uniform supply from month to month, had no advantage over the farmer with a summer dairy, who let most of his cows go dry in the winter.



A graphic illustration of variations in the quality of milk from two herds, as furnished to the Boston milk contractors. The upper line shows a case where the milk was watered. The lower line is a story of milk of uniformly good quality. (See page 82.)

Mr. C. M. Bull, the manager of the Springfield Milk Association, finds the same trouble there. In September the receipts were 2,000 quarts per day less than in May, with a demand of 1,000 quarts more; new farmers were taken on to supply the deficit, which also increased the surplus in the months of largest production.

Cream.

The sale of fresh cream is increasing rapidly, and within the past half-dozen years has reached large proportions. In many cases cream takes the place of milk. But population increases so rapidly that we find no falling off in the consumption of milk in consequence of the cream trade. The supply of cream is handled by the regular milkmen, and also by farmers who make a specialty of producing cream and delivering it in the town or city by private teams or express. The Boston milk contractors do a large cream business, and several Maine creameries are now shipping great quantities to distributing agents, who deliver it every morning to families and to stores. Signs of "Fresh Maine cream received daily" are common in many grocery and provision stores. In 1894 the Turner Centre creamery reported to the State commissioner that it had sold 140,000 gallons; the Hampden, 56,175 gallons; and the Bangor, 10,500 gallons. Most of this went to Boston, and for it there was paid to Maine farmers over $85,000. This year the Turner agent informs me that cream has been shipped to Massachusetts to the value of $60,000. Livermore Falls and Monmouth creameries are shipping 150 gallons per day to Lynn.

A complete census of the city milk business would also include large sales of condensed milk, for in a large city like Boston many small families and shop girls live in lodging-houses, practising light housekeeping, and find condensed milk very convenient.

An interesting phase of the milk business has been going through the experimental stage in Boston for the past few years, and is now so successful that it is being extended into other cities. It consists in preparing from cream, skim-milk and sugar of milk a modified milk of just the quality desired for invalids and very young children. In many cases health is so precarious that the physician desires to know accurately the precise amount of food consumed by his patient. He therefore writes a prescription for a milk of a certain designated percentage of each of the different solids. This is prepared at the laboratory, the milk sterilized if so desired, and then delivered in small bottles.

Several problems present themselves in connection with the city milk supply.

First Problem, — Financial.

The first problem is in relation to the financial profit of the business. There seems too big a gap between what the farmers receive and the consumers pay, so far, at least, as the Boston supply is concerned. The average price received by the farmers is not over 3 cents per quart, and the average price paid by the consumer is 7 cents. Four cents, 133 per cent more than the farmers receive, is divided between transportation companies and middle-men. The sum seems too large. Many farmers who keep both a farm and a dairy account, charging the dairy with what is raised on the farm at the market price, find that their milk costs even more than it brings; and, figuring the cost of milk at the cost to produce hay, ensilage, etc., the profit is not large.

A practical difficulty in righting this apparent wrong confronts us at the very outset, in the fact that the price, poor as it is, stimulates more production than there is a demand for. The milk car furnishes to many farmers a steady and prompt cash market for the farm product, particularly those situated a considerable distance from the city. Sometimes this is especially burdensome for the near-by farmers, living on expensive land, and often having to buy nearly all of the feed for their cows; they have but little if any advantage in the extra freshness of their milk, for it is usually retailed at the same time as that from the longest distance. Morning's milk is sometimes put on the cars the day of production, but usually all goes into the peddler's mixing tank together.

The present price is enough to produce a surplus, and when there is offered for sale more of any article than the demand calls for the price must necessarily be weak. With improving facilities for transportation the milk routes are being extended or more territory added, so that no relief seems likely.

Three thoughts under this head are suggested: First, the experiment stations are showing us that there are wide variations in the cost of production; some rations cost a great deal more than others equally good, so that, with study and investigation on this point, the farmer can oftentimes reduce the cost of production. Second, by appreciating thoroughly the value of the elements of fertility sold from the farm in whole milk, there may be less of a desire to rush so much whole milk upon the market. Butter takes almost nothing from the fertility of the farm, the nitrogen and mineral part of the milk being left in the skim-milk. A butter farm, using its skim-milk at home, will constantly improve; but a milk farm must constantly buy grain and fertilizer, or it will run down. The reiteration and explanation of these facts by the State Board may possibly remove the impetus to supply the market with so much of a surplus. Third, the producing an extra quality of milk at an extra price may be possible in more cases. Fourth, organization of the producers has been of much benefit, and has even more possibilities.

SECOND PROBLEM, — THE STANDARD.

Another problem growing out of the milk question relates to the standard. Should there be any statute standard, — that is, should the State by law prohibit the sale of pure milk when its quality is below an arbitrary standard? Some good and intelligent people say "No." A person interested in maintaining the negative could quote the English practice, which is in effect to have no standard but the poorest milk which it can be proved has been drawn from the udder of a cow, and not artificially adulterated. In this country no less an authority than the Hon. Edward Atkinson is on the same side.

Need of a Standard.

Every one will agree that the Legislature ought not to meddle with an article whose quality can be readily and conveniently determined. But, in case of an article of which it is impossible or inconvenient for the public to judge, the almost universal opinion is that a legal standard should be fixed. There is a gas standard and an oil standard; there are standards for drugs and for liquors; a standard age for veal is established. The impossibility of ordinary people promptly judging of the value of jewelry has led to the prohibition of peddling it. Milk is particularly an article of which the consumer cannot readily judge. It is left at his house often before he is up in the morning, and must go into immediate use. He has no appliance or opportunity for examining the quality, and usually cannot take the time or trouble to look up the proper officers and present a sample to them. In other cases where there is such difficulty in determining quality, and where there is a possible wide variation in it, the law steps in and establishes an arbitrary standard.

Milk of unquestioned purity was found at the Ohio State fair with 8.41 per cent of solids, and it sometimes has as high as 20 per cent. This means that a purchaser may get anywhere from 8½ to 20 pounds of food for every 100 pounds of milk that he buys; and under existing conditions it means that the farmer who makes superior or even average milk must sell some of his milk solids in competition with water from his neighbor's cows.

If some system of ready testing could be adopted, and then if milk could be sold on its merits, at a price proportionate to its food value, no law would be necessary. That would be an ideal condition. I look forward to the time when the Babcock or other similar test will become common, and the people so intelligent that milk can be sold at various prices according to the varying qualities. But that time has not come as yet. Consequently, the circumstances justify a Legislature in designating a point below which one cannot go in selling milk. Courts have affirmed this principle, and common-sense ratifies the decision. Such a statute is needed to protect the consumer against fraud. Water, even if drawn from the cow's udder, has no more food value than it has when drawn from the pump. A standard is needed in the interests of agriculture to save the producer of the better qualities of milk from competing with what the supreme court of Rhode Island denominates as "an article useful for irrigation only."

An arbitrary statute standard is further needed, in the interests of a good and progressive agriculture, to check a tendency which always exists in the sale milk business,viz., a tendency to breed down instead of up. By continuously breeding from cows that produce large amounts of milk, regardless of quality, we raise up generation after generation from whose udders is drawn more and more milk which is steadily growing poorer and poorer. Breeding for a purpose can accomplish much; but when that purpose, expressed or implied, is a deterioration in quality, it is not identical with the best agriculture, and demands a check. This it receives in a law which says, "Thus far shalt thou go and no farther," by prohibiting the sale of any milk below a designated quality. A compilation of ten years' records of the State Board of Health shows an increasing per cent of samples below the standard. Though this includes adulterated milk, it probably shows that there is an increasing number of cows producing poorer milk, as a result of the tendencies of the sale milk business.

Another reason for a statute standard of milk is the help it gives in prosecuting those who adulterate milk. Within certain broad limits the chemist can tell by the proportion of the different solids in milk whether it has been tampered with. I recently met a case where analysis showed that a certain sample of milk had 4 per cent of fat and 7.75 per cent of solids not fat. The relation between those two figures told beyond doubt that the milk had been watered, for normal milk with 4 per cent of fat should have at least 9 per cent of solids not fat. But the case is not always so clear. Within narrow limits water or skim-milk could be added, or some cream removed, and detection would be difficult.

Hence a statute standard may be a great help in detecting the man who deliberately cheats the consumer by adulterating milk outside of the cow.

A report of the milk supply of London, by a special analytical and biological commission, in the "British Medical Journal" of July 6, 1895, says that "in an endeavor to enforce purity it is of the first importance to be able to define what is meant by pure; and it will be seen that the establishment of some arbitrary standard of pure milk is an essential preliminary to any effective action being taken to put an end to the wholesale sophistication by which the poor especially are injured and imposed upon. Those who maintain that whatever can be milked from a healthy cow is milk, are able to show extraordinarily poor specimens, which, for all their poverty, are still milk. The English laws are intended to prevent the sale, not of milk of poor quality, but of that which has been fraudulently tampered with, so that the public analyst is bound to pass as genuine all milks which are at least equal in composition to the poorest genuine milk, although in a great majority of cases thus passed he has to do with milk artificially and not naturally weak. If a high standard were fixed, the result would be to condemn much genuine milk; while, if a low standard were adopted, good milk would be watered down to it. A standard should be fixed with which all milk that is sold should conform, and, however pure or genuine the milk may be, it ought not to be allowed to be sold as whole milk if it is below standard."

The greatest good to the greatest number seems to call for a statute standard. Unquestionably, it arbitrarily stigmatizes as unlawful the sale of some pure milk which has some food value, but the end justifies this small amount of theoretical wrong.

What shall the Milk Standard be?

Massachusetts has answered 13 per cent of solids, except in May and June. The question, therefore, practically resolves itself to this: Is the Massachusetts standard of 13 per cent, which is the same in Minnesota and New Hampshire, too high? There is some opposition to this standard, and hardly a winter goes by without an effort to have the Legislature reduce it. This is my excuse for taking time to consider an old question.

I desire, at the outset, to consider parenthetically one phase of the enforcement of the law. All laws should be enforced with reason and common-sense. This is not the opinion of a mere laymen, but it has the highest of legal authority. In the case of a statute designating a date after which it would be illegal to be found with certain game in one's possession, no officer would think of arresting a man because he had such game, as the tones of the clock striking the hour of midnight died away in the distance, or even at one, two or three o'clock in the morning; but, should an officer make an arrest for such a narrow violation of law, it is doubtful whether any court would convict. Similarly, in the case of a statute standard of 13 per cent of solids in milk it would be impossible to secure a conviction on milk which had 12.9, 12.8 or even 12.7 per cent of solids. Those who ask for a reduction of the standard claim that the law should be enforced to the last one-hundredth of one per cent, hoping thus to make it unpopular; and they argue that the officers who fail to enforce the law in this way fail to do their duty. But milk inspectors, the Board of Health and the agents of the Dairy Bureau, acting on the best of legal advice, would not enforce the law so literally if they could. Furthermore, they could not if they would; for no case can be entered in court without the consent of the judge, and to his judgment much latitude is allowed. No judge will entertain a case of a technical, hair-splitting violation of law, nor unless the evidence is sufficiently strong to make guilt almost certain. Hence, milk must be sufficiently below the standard to make conviction reasonably sure, even if the defendant has the services of some talented criminal lawyer, who works zealously for his client, and who uses all his ability to throw suspicion on methods of analysis or accuracy of the sampling. Consequently, in the enforcement of the milk law the enforcement standard is usually not over 12.5 per cent; and if the statute standard were to be lowered, the enforcement standard would have to be correspondingly reduced.

With this explanation of the slight elasticity in the standard for purposes of legal prosecution, we return to the query, Is the present standard too high? On one point all can agree; one fact is so well established that there can be no dispute about it, — namely, average milk has 13 per cent of total solids. A volume of authority could be quoted on this point.

The Average Quality of Milk.

The United States department, in its hand-book of experiment stations as well as in its annual reports, alludes to 13 per cent as being the average. Major Alvord, the chief of the dairy division, says that normal milk ranges from 10 to 15 per cent of total solids. The Massachusetts experiment station has made 1,889 analyses, and finds the average 13.47. A few years ago the Massachusetts Board of Health concluded that the standard adopted by the statute was a little below the general average of milk throughout the State, having found the general average for total solids to be between 13.2 and 13.3.

The Boston milk inspector finds that the samples taken by him average above 13 per cent; a majority of even the suspicious samples are all right. Mr. Blair, the chemist for C. Brigham Co., milk contractors, finds that the average analysis of milk received by that company is 13 per cent, or above, and this average includes occasional samples of watered milk. The milk on the company's Brookfield car in 1894 was analyzed 1,170 times through the whole year, and the average was 13.23. More than one-half of the samples taken by the Board of Health, including those that are adulterated or suspicious, are above the standard. Professor Goessmann, reporting to the State Board of Health that increasing density of population is coincident with decreasing quality of milk, finds in the western part of the State only from 19 to 22 per cent of the specimens below standard.

The New York experiment station analyzed at one time 938 samples, and found the average 13.64; it was found that Jersey milk averaged 15.4. The Maine experiment station report for 1894 gives analyses of the milk of three cows for twelve weeks each, averaging 13.23. The Connecticut report in 1891 gives a number of analyses which averaged 12.99. A return from 49 cheese factories in New York in 1893 gave the average 12.72. Professor Babcock says the average composition of milk is 12.8 per cent of total solids. The Lowell milk inspector, averaging his analyses by the month, finds the range of monthly averages to be from 12.47 to 13.57; this includes samples of adulterated milk. In the ninety-day dairy tests at the World's Fair at Chicago the average was 13.41. In England 120,540 samples were analyzed by the Aylesbury Dairy Company in eleven years, between 1881 and 1891, and the average was 12.90.

Professors Robertson, Chandler and other authorities all allude to the average composition of milk as being 13 per cent. In Johnson's encyclopædia twenty-one authorities quote an average of 13.32. Professor Cooke says: "The Massachusetts law requires 13 per cent of total solids, and that is not a bit too high. No man ought to keep cows who would give less than that. But the average composition of the milk produced in the whole State of Vermont is a little above the Massachusetts standard. It will run 13.5 per cent, and very likely 14 per cent is the average of the total solids of the milk in this State. That being the fact, there is certainly no reason why Massachusetts and other States cannot get milk that is 13 per cent. It is not necessary that you should have cows that give a small amount of milk, because cows can easily be found that give moderately large quantities of a good quality of milk."

This line of proof could be continued at great length, but the evidence would be merely cumulative. It can be considered as an established fact that the well-mixed milk of various cows in various stages of lactation will rarely if ever be below the standard, and will be quite uniform in quality from day to day. I think that this proves the justice of the Massachusetts standard. I do not see how any one can dispute the proposition that the purchaser of any article of variable composition is entitled to receive average quality. The consumer who pays the regular, or average, price for milk, and does not get an average article, — 13 pounds of food in 100, — is wronged; and so far as his rights go it makes no difference whether the wrong is due to the physical inefficiency of the cow or the moral delinquency of the milkman.

But I understand well what the word "average" means. I admit that injustice is sometimes done by basing conclusions on averages. An employer who overpays one man by giving him fifty dollars per week and who underpays another with only ten, does an injustice to both, while he averages to pay reasonable and fair wages. We all have heard of the tippler and total abstainer who averaged to drink brandy and water, but one drank the brandy and the other the water. I know that, though the average composition of milk is 13 per cent of solids, much milk is below the standard; and I will not be so hasty as to assume that I have proved the justice, or even the expediency, of the statute standard by the fact that it represents the average quality of milk. I am willing for the sake of fair play to follow the discussion a little further. Is any injustice done by the law? Why is a change demanded? The 13 per cent standard being on the statute books and being the average composition of milk, the burden of proof is upon those who ask for a change. What are the claims which they make?

Objections to the Standard.

First. — "The law makes illegal the sale of much wholesome food." This claim at first glance seems to have much force, and there would be much common-sense in it if the advocates of a change in the law were asking for an opportunity to sell low-grade milk at a low-grade price. But that is not what is wanted. The opponents of the present law ask to have it modified so that they can sell 11 or 12 pounds of food at the same price which the average producer receives for milk of average quality. If some practical law could be drafted, which would not be full of loopholes for the advantage of the dishonest, by which the milkman could state what he sells and sell what he states, I would not object. If it were possible to have a 13 per cent standard and also one of 11 per cent, for instance, each kind of milk to be properly marked and labelled and sold on its merits, there could be no objection. (I have no faith in the possibility of such a law, in view of experience with the tendency of human nature to evade the provisions of the skim-milk law.) But it does seem wrong to ask the right to sell 10, 11 or even 12 pounds of food at the 13 pound price. The State Board of Health said in 1892: "Strangely enough, the pretence is often urged by milk producers that milk containing 11 or 12 per cent of total solids is quite as wholesome or nutritious as that which contains 13 or 14 per cent of solids. The absurdity of this argument is plain enough, since, if it were true, it might reasonably be asserted that milk having 7 or 8 per cent of solids is as wholesome as that which has 11 per cent, and so on *ad infinitesimum.*"

Second. — "The honest farmer is always in imminent danger of prosecution; a legal sword is constantly dangling over his head by a hair, ready to descend without any warning." This point exists in imagination rather than in actuality; but at a committee hearing, or where the demagogue can get attention, the statement can be amplified in thrilling and plausible language, just as ghost stories can be told which will make your blood run cold and your hair stand on end, — but there are no ghosts.

Average milk has 13 per cent solids, and the average mixed milk of average cows is constant in quality. Milk below standard is the exception. When it is found, unless it is very bad, a warning is sent and subsequent samples taken. If improvement is shown, no prosecution results. Even when complaint is made and the milkman found guilty, the court can put the case on file, instead of imposing the statutory fine, if there are mitigating circumstances. Hence the chance of trouble is slight. Figures reveal the same thing.

The State Board of Health examined 3,551 samples last year, 287 warning notices were sent out, and finally 76 complaints were entered in court; of these, 63 resulted in conviction. Half of these cases were for milk below 11 per cent of solids. In 1893 the Cambridge milk inspector took 1,882 samples of milk; 26 were not of standard quality, and, after sending out warnings and following the cases up, 8 complaints were entered in court. In Lowell in the same year there were 1,258 inspections; 26 warnings that milk was below the standard were sent out; in almost every case they caused an improvement in the quality of milk sold, and, out of 1,258 samples taken, 17 cases were entered in court. The Boston milk inspector, for the year ending Feb. 28, 1894, reported 13,623 samples of milk examined, out of which 267 prosecutions resulted. These figures, which include all the adulterated cases, show what slight danger there is of prosecution. I took at random one of the Boston milk contractor's books, and found that out of 1,000 analyses there were 58 instances when the milk had been so bad as to call for letters of complaint.

Third. — "Under the law an honest man may be branded as an adulterater of milk." This is similar to the above. At hearings before legislative committees, where an attempt is made to reduce the standard, we are occasionally treated to sympathy-stirring portrayals of the man of high standing in his town, very likely a deacon in the church, who is summarily dragged into court, because, forsooth, an innocent cow happened one day to give milk of less than 13 per cent solids; and for this temporary delinquency on the part of the cow we are told that the exemplary citizen is branded on court records as one who has deliberately adulterated milk with the purpose of swindling his fellow man.

There is a theoretical possibility of such things. It is true that the law makes no distinction between milk below standard naturally and that below standard through the artifice of man. But, between the average quality of milk, the leeway required by the courts and the prevailing system of sending out warnings, the danger of prosecution, as shown under another head, is extremely microscopic. It is not wholly wrong, however, that the law is just as it is on this point. One court has said that there is no difference between watering milk inside the cow and watering it outside of her. The Rhode Island supreme court, in a decision sustaining a milk-standard law, says that "if a cow habitually gives milk below standard, she is of no value to her owner as a milk producer, unless he can sell her milk to his unsuspecting neighbor for a price in excess of its value, — a species of fraud which ought not to be tolerated. The section is but a slight extension of the provision which prohibits the sale of adulterated milk, and, like that, was designed to protect the public against imposition."

There is one danger to milk producers which is common to all occupations. All persons employing help are liable for the acts of their employees, and hence a morally innocent man may in a few extreme cases be legally guilty of selling milk which has really been adulterated by the hand of man, — some employee. A conscientious and high-minded editor from Philadelphia was in Boston a few days ago. While in that city something appeared in his paper which an aggrieved party thought to be libellous, and on the gentleman's return to his home he was arrested on a charge of criminal libel. Morally he was innocent, technically he may have been guilty; his arrest was one of the perils of living and doing business.

A case was noticed in a local paper a few weeks ago as being so excessively aggravating as to call for an editorial denunciation of the milk law. I found that the criticism of the law was based merely on the fact that the convicted man was of excellent standing in the community, — a man whom every one respected and esteemed. Investigation showed that he had received four warnings from the contractor to whom he sold milk that it was below standard; in spite of that, it did not improve, but at length analysis disclosed such a disproportion between the solids not fat and the fat that the conclusion was inevitable that the milk had been watered. The case was then turned over to the Board of Health, whose inspector took samples of the milk, and he, too, found that it had been watered.* Though the case appealed to the sympathy and good-will of the defendant's fellow townsmen on account of his general integrity and good character, there could be no disputing the fact that some one had fraudulently added water to the milk.

As there is a well-established relation between the solids not fat and the fat, and as it has been abundantly proved that 13 per cent milk will have about 3.75 per cent of fat, the cheapness, accuracy and convenience of the Babcock test make it possible for every farmer to keep track of the quality of what he is sending to market.

Fourth. — "Enforcing the law occasions much trouble." This we hear sometimes from Boston milk contractors when they have been exceedingly annoyed by milk below standard, after repeated warnings have been sent; but the trouble of enforcing a law is no argument against it. If such a claim were to have weight, nearly all of the criminal statutes now in force would be repealed.

Fifth. — "There is much difficulty in making standard milk." If a majority of farmers can and do produce milk of standard quality, the minority can do the same if they will make the conditions the same. If the continued policy of any milk producer is to get cows that will give the largest product possible, with no thought of quality except barely to save himself from legal prosecution, he has no right to say that it is difficult to make standard milk.

Sixth. — I find our law denounced in a New York dairy paper as an attempt to "instruct the Lord," with the assertion that "a law making it illegal to sell milk under 13 per cent total solids might well be followed by one making it illegal to sell an apple weighing less than four ounces or a pig with a tail less than three inches in length." This attempt to ridicule the law is no argument, but advertises the ignorance of the person who makes it. The whole theory of a statute standard is the protection of the interests of the consumer against a fraud, and, indirectly, the protection of the interests of the best class of producers.

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* Fat, 4.0; solids not fat, 7.94; total, 11.94 per cent.
Fat, 3.3; solids not fat, 7.74; total, 11.04 per cent.
Fat, 3.6; solids not fat, 7.68; total, 11 28 per cent.

Arguments for the Standard.

Having thus considered the need of some standard, and the fact that the present standard represents the average quality of milk, and having also noticed the reasons commonly urged for a change, I have already indicated why I favor the 13 per cent standard, in the interests of the majority of milk producers as well as of consumers. Some of the points which I wish to make, by way of recapitulation, are as follows: —

First. — A reduction of the standard would be an injustice to the majority of farmers who produce standard milk, in three ways, — by increasing competition through an enlarged supply, by reducing the price on account of an increased surplus and also by decreasing consumption. The present law and its enforcement have done much to increase popular confidence in the milk supply, and have thereby increased the consumption, which might be injured by a decrease in the average quality. The "London Lancet" says that a statute standard "has a tendency to raise and maintain the quality of the milk supply."

Second. — A reduction would be an injustice to the consumers. The "British Medical Journal" says that the low standard has done great injury to the consumer as well as to the honest producer and vender.

Third. — A reduction would be only a temporary remedy for the troubles of the minority. With a continuation of the process of breeding down, in a few years there would be a respectable minority of cows whose product would be below the lower standard, were it 12, 11 or even 10 per cent. I have already spoken of the cow at the Ohio State fair which produced 8.41 per cent milk in competition for a prize for cows giving the greatest quantity. Producing quantity without thought for quality is like continually driving as near the edge of a precipice as possible; one has only himself to blame if some day he goes over. Moving the precipice would give no relief, so long as the venturesome proclivities remained. I do not mean that some farmers *deliberately* try to get as near the line laid down by the statute as they can without crossing it, but the drift of events leads practically to that result.

What causes Variations in the Quality of Milk?

In leaving this point, let us briefly consider what causes variations in the quality of milk, and summarize the scientific work of our experiment stations and others up to date.

The mixed milk of mixed cows, as stated, is quite uniform in quality. Mr. Clemence of the Board and the Dairy Bureau has tested the mixed milk of his herd of common cows with the Babcock tester every few weeks for nearly two years, and has found a fat variation of only about .3 of 1 per cent.* But the milk of individual cows is constantly varying from day to day, and the range is more than in Mr. Clemence's case ; but it is usually less than 1 per cent, always returning, however, in a day or two, to the average. But, if the milk of one cow were mixed with that of other cows, these sharp differences would be toned down and the milk would be of more uniform quality. The cause of some of these changes is unknown, and opens a field for interesting and valuable work by experiment stations.

Cows fresh in milk give poorer milk than do strippers, hence, to have milk of as even quality as possible, there should not be too large a proportion of new milch cows at any time.

Breed has much influence on the quality of milk, some breeds averaging richer than others. But skilful breeders have developed rich milkers in the breeds which usually give poorer milk, and have often got good dairy families from the so-called beef breeds. On the other hand, negligent breeding, or what is as bad, breeding for mere quantity, will develop animals in the richest dairy breeds which will give low-grade milk.

Careful feeding of animals through several generations is one of the influences that tend toward the development of

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* Recent complete chemical analyses resulted as follows : —

	1.	2.	3.	4.
Solids not fat,	9.46	9.40	9.58	9.46
Fat,	4.24	4.44	4.06	4.06
Totals,	13.70	13.84	13.64	13.52

better cows. But there is much popular misapprehension as to the influence of feed on milk. If an animal has enough, changes of feed make but little difference in the quality of her milk from day to day.

This remark is rank heresy to many, but its truth is endorsed by almost every scientific experimenter who carefully weighs and analyzes. You cannot give the 2.30 horse an extra quart of oats to-day, and expect a record of 2.25 to-morrow. You cannot feed an 11 per cent cow to make her become a 14 per cent animal.

In days past, when the milk of some dairy supplying Boston was below standard, the contractor would write to the producer that he must feed more grain; and often the farmer found from experience that change of feed did not bring milk up to the standard.

Professor Whitcher said, before the State Board last year: "When you feed a well-balanced ration to any given cow, it does not make much difference as to the quality of the milk whether you feed one or the other of the rations. If she is a cow that is going to give milk that has 4 per cent of fat in it, she will give that quality of milk and no natural system of feeding will affect the same. I have never found a ration on which I could say I could increase or decrease the amount of fat a cow would yield on a normal ration. I feel confident that the per cent of fat is not easily varied by changing the food, even by a radical change."

The Maine station in its 1894 report touches upon some feeding experiments, and in conclusion it says: "The writer cannot resist the temptation to call the attention of those who believe that the ration largely controls the quality of milk to the fact that, although the cows lost flesh and diminished greatly their product, the quality of the milk seems not to have been influenced."

The Vermont station investigated the effect upon milk of practically doubling the grain ration, — *i. e.*, increasing the grain fed from 6 pounds daily to 12 pounds daily, — and found only small changes in the quality of the milk, which could in no way be attributed to the ration. It says that, where foods of equal nutritive value are given, when cows are under uniform conditions there is practically no change in the character of the milk. And again, "Attempts to increase the richness of milk by changes in kind or quantity of feed have not as yet been successful."

The "Hand-book of Experiment Station Work," which gives a summary of experiment station results up to 1893, in discussing the effect of food upon the quality of milk mentions but one experiment out of a large number noted where a direct and important change in the kind of milk appeared to be due to the variations in the food; viz., an experiment at the Iowa station, in which gluten meal was substituted for corn meal.

Most of the experiment station work relates to feeding up, and has been done in connection with butter-making, in studying how animals can be cared for and fed so as to produce the greatest amount of butter fats, and how their milk can be enriched. The vital question in connection with sale milk is in producing a liberal quantity, which will come up to 13 per cent; but little has been done in an experimental way in relation to this phase of the question, and little is known as to how far the quality of milk can be depreciated by feeding slops or exceedingly watery food to secure quantity.

The Wisconsin experiment station in 1890 said that in a majority of cases an increase in the quantity of water drank was followed by a coincident increase in the water in the milk. But the Vermont experiment station claims to have proved emphatically that pasture feeding and watery food do not make watery milk.

Environment. — The cow is a nervous animal, and the quality of her product is often influenced by her surroundings. Conditions that bring discomfort, whether heat, drought, cold, harsh treatment, or boisterous, unpleasant noises about the stable, will often cause deterioration in the quality of milk. The effect of climatic conditions is not as well known as it ought to be. The analyses of the Aylesbury dairy show that a winter of unusual severity and length, long spells of cold and wet, as well as of heat and drought, affect the quality of milk somewhat.

Individuality. — This is the great factor influencing the quality of milk. The milk of some cows is almost uniformly above the standard, "because they are built that way;" other cows are always below that standard, because of their individuality. If any person has permanent trouble in producing milk up to the standard, the cause is doubtless with the kind of cows he keeps. Introducing into the herd those that give richer milk will bring up the average quality of the mixed milk so that it will be all right. There is nothing in bovine nature repugnant to 13 per cent solids; it is as easy to make 13 or even 14 per cent milk as 11 or 12 per cent, by getting proper cows to secure that result, though at present prices it would not be profitable. Offer a sufficient financial inducement, and in a few years every farmer in the State would have cows that would produce 15 per cent milk. Professor Cooke and many others have said that the individuality of the cow is the leading factor in the case, and feed is subordinate.

Some Illustrations.

Before leaving the discussion of the quality of milk, I desire to introduce graphic illustrations of some actual tests of milk. They were taken under such conditions that their value must not be over-estimated, but they are exceedingly interesting. Each of the large Boston contractors employs a chemist who intends to take one sample each month from each dairy that furnishes his company with milk. This is analyzed and the result is recorded. These results are not conclusive proof of the average quality of milk. They include adulterated milk and milk that has not been thoroughly mixed. If changes have been made in the animals in a herd, there is no knowledge of this fact or of how the cows are cared for. If the herd has an undue proportion of new milch cows or strippers, that fact does not appear.

In the accompanying figure the lines *A* and *B* represent the average of the analyses of milk for two different cars for four years. *A* * is almost uniformly above the standard, and at times much above it, while the other car (*B*) is below

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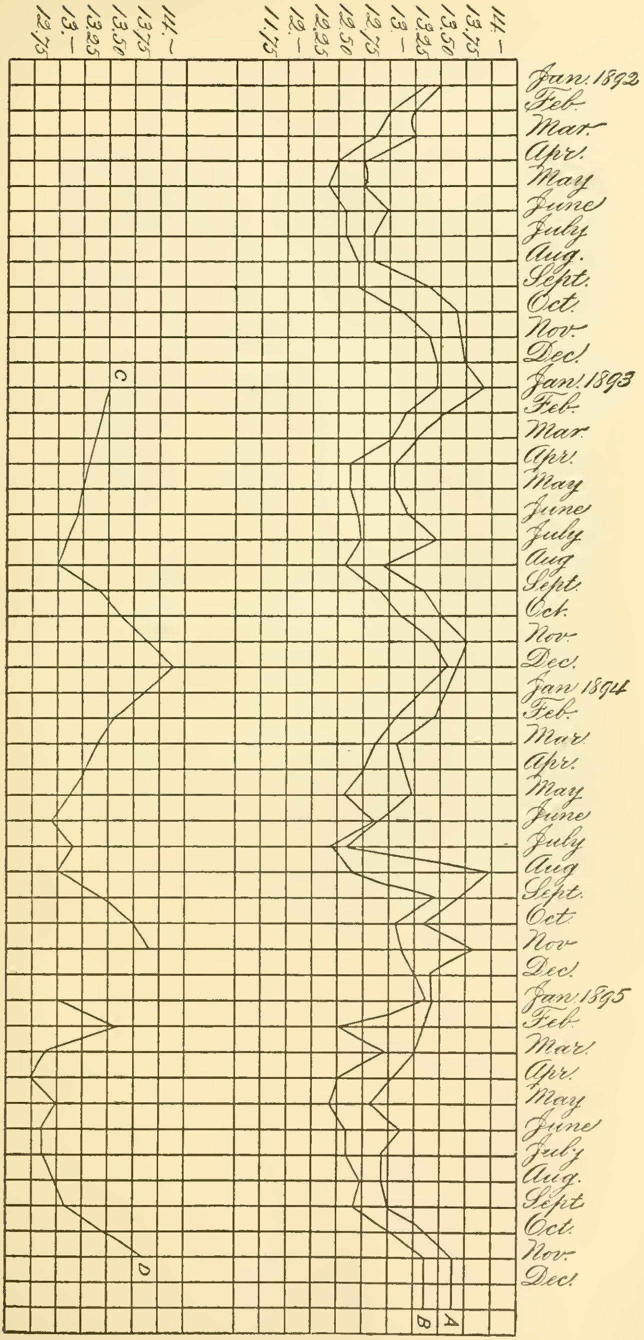
* The Brookfield car.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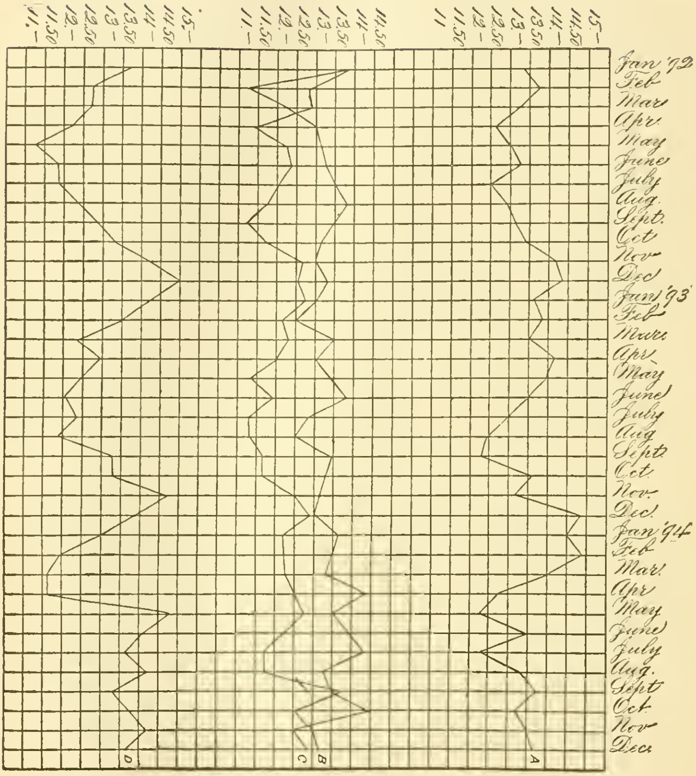
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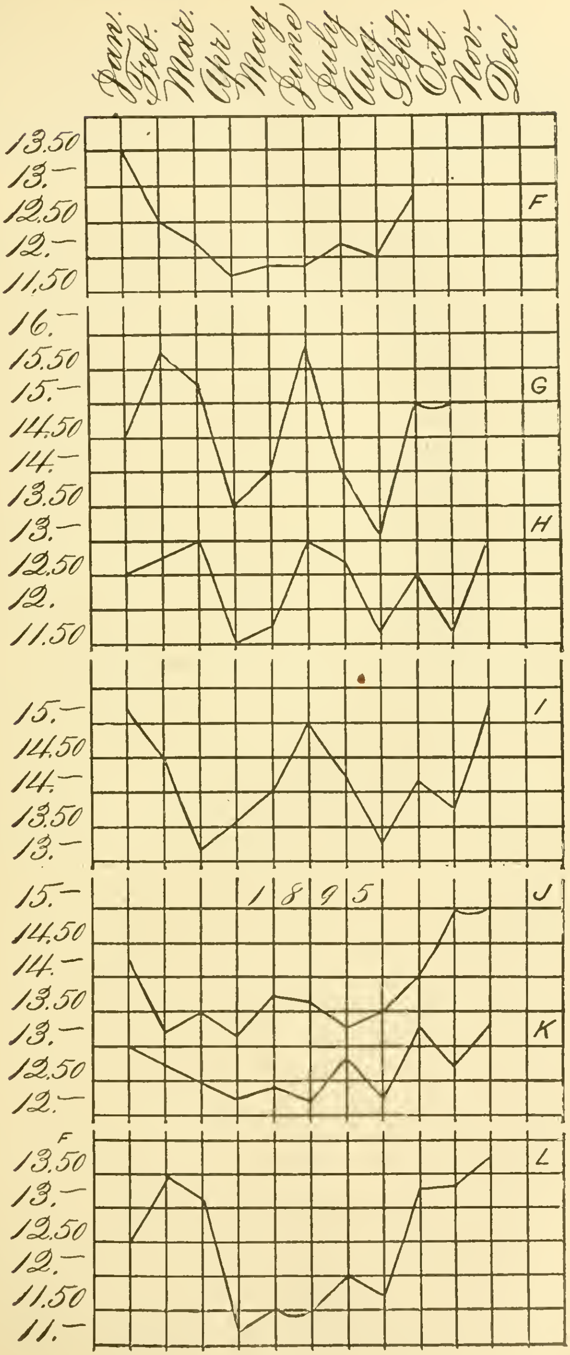
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the standard most of the time. The lower part of the engraving shows the quality of two other cars, one for the years 1893 and 1894 and one for 1895. In one case (*C*) the milk is uniformly above the standard; in the other case (*D*) it gets slightly below more of the time, but not enough to make any trouble for the dealer.

The other engravings show the analyses of the milk of herds. *A*, *B*, *C* and *D* (see p. 80) are the records of four herds for three years. *A* is almost uniformly above the standard, seven months of the time it was 14 per cent; but the extremes may possibly be milk which was not thoroughly mixed. *B* and *C* show in contrast two herds, one of which is almost uniformly above the standard, while the other is as uniformly below it. *D* is a herd showing wide variations, running from 11.25 in May of 1892 up to 15 per cent in December of the same year; this record suggests the possibility of improper mixing, or of having an undue proportion of new milch cows at certain seasons of the year.

F is a herd almost uniformly below the standard (see p. 81). *G* and *H*, as well as *J* and *K*, are interesting to study together, showing the difference in different herds. *G* and *J* never got as low as 13 per cent, and *G* was over 15 per cent five months of the year, while *H* and *K* were constantly below 13 per cent. *I* is the record of another herd uniformly above the standard, while *L* is almost constantly below the standard. The upper line on page 59 is peculiarly interesting, on account of the wide variations in the quality of the milk of the herd, ranging from 11 to over 16 per cent. Another interesting fact in connection with this herd is, that two analyses show that the milk was watered, a complete analysis for the month of May being 7.5 of solids not fat and 3.5 per cent fat. In June the analysis was 7.78 solids not fat, plus 4 per cent fat, making a total of 11.78.

E is the story of a herd from July, 1892, to November, 1894, the milk of which was more constant in quality, and was, with one exception, on the standard or above (p. 59).

This interesting field of investigation could be carried much further, but enough has been presented to show that some herds are always above the standard, some almost always below, and that others hover about the line, occasionally crossing it. The study of such herds, their breeding, length of time in milk, with the tests of the individuals making up the herd, would be very interesting and valuable.

THIRD PROBLEM, — SANITARY.

Quality in milk means more than total milk solids, — it includes cleanliness and healthfulness. I have seen an estimate that from three hundred to four hundred pounds of manure are daily swallowed in New York in the milk supply. The commercial fraud of selling milk of less than average food value is the whitest of innocence as compared with selling germs of typhoid fever and tuberculosis; yet in the case of milk solids we have ample legislation, but practically none in the case of dirt and disease. I am aware that there is a law prohibiting the sale of milk from "sick or diseased" cows; but it does not amount to much, for lack of legislation to enforce it. There should be some system of inspection of herds supplying cities with milk, which should not only take cognizance of the health of the animals but of the cleanliness of the stable, the amount of air and sunlight it receives and the care of the milk before leaving the farm. Modern investigation tells us that souring is caused by bacteria which get into the milk after it is drawn. If milk could be kept absolutely free from bacteria it would practically keep forever; or, in the more terse language of Professor Sedgwick, "short-lived milk is usually filthy milk." With more care there would be no sour milk returned to the producers and no losses to consumers from the milk curdling in the can almost before it is taken into the house.

This inspection should go so far as to include the existence of contagious diseases among those who have the handling of milk and milk utensils. The Board of Health has done some excellent work in investigating outbreaks of typhoid fever and their relation to the milk supply. But the work should go further than this, and should include precautionary measures, as well as the study of causes after there has been resultant disease. Pasteurizing milk so as to kill the germs it contains has much to commend it; but how much better it would be to have no germs there, or at least to reduce them to the least possible amount. Sanitary inspection of herds may provoke criticism as a possible means of subjecting the farmer to unnecessary annoyance. But I believe that a majority of the most intelligent, broad-minded agriculturists admit that it is right to aim at furnishing as good a product as possible, and that studying the interests and tastes of the consumer tends in the long run to enhance the welfare of the producer. This legislation should not be undertaken hastily. It should be conceived in a spirit of friendliness to the interests of agriculture. There should be nothing about such a law or its enforcement that would subject the farmers to any undue hardship or to annoyance from any arbitrary martinet. It would be well if the agitation should be commenced by the farmers themselves, not only to show that they are interested in the quality of the product they sell, but to insure legislation in sympathy with them, and to see that the enforcement of the law is placed in the hands of their friends. Such legislation is sure to come, and if the farmers are prominent in securing it, it may be more satisfactory to them than if it is forced upon them; and it may avoid objectionable features that would be engrafted in a law enacted by excited or frightened city interests in possession of only half the truth.

IN CONCLUSION.

The future of the city milk business at times seems discouraging, especially when we consider the increasing distances that milk can be transported, and the consequent increasing number of farmers and amount of territory which must compete for the business where there is already a frequent surplus. Formerly the superiority of fresh over "stale" milk was often urged, but in the light of modern bacteriological studies this difference has largely disappeared. Milk produced one hundred miles away, if clean and properly handled, may be better when twenty-four hours old than that produced even in the city limits when only five hours old. The way milk is cared for is of more importance than the distance it has been transported. On the other hand, we must remember that milk is largely composed of water, and that there is a limit to the distance which it can be freighted.

Besides this, the cities are growing rapidly, and calling for more and more milk. A study of the map shows that Massachusetts is becoming thickly settled; and that, between the thirty creameries, its many private butter dairies, one condensed-milk factory, the milk cars and the near-by consumption, there are many localities where all the milk that is produced finds ready sale. This is emphatically true of Essex County. In portions of Plymouth County during the summer-boarder season there is an absolute shortage. Rhode Island is reaching over into this State for milk for her flourishing cities. Even in the less thickly settled western portion of the State there are not a few towns where milk is in quick demand. Two creameries in this State and one just over the line in Connecticut have been closed within about a year on account of the demand for milk from the cities. Hence there seems to be a prospect for an increasing demand for milk from Massachusetts cities at a moderately satisfactory price.

With a standard unreduced, and with better sanitary inspection, the demand per capita will also increase. Milk is the cheapest food there is, — except the cereals, — and with increasing guarantees as to its quality the consumption will increase. There is need for some educational work in the city as to the food value of milk and the average good quality of that now sold. Only a few days ago I met a very intelligent gentleman, who remarked, "I suppose we get pretty poor stuff for milk in Boston." When I explained to him the system of inspection and its thoroughness, he was much surprised.

It also seems as if there is a good opening for business enterprise to put milk on the market guaranteed to contain 14 or even 15 per cent of solids, and from inspected herds. Such milk would pay an extra profit.

But, although the milk situation has both its light and its dark sides, when we strike the balance, when we look at the general agricultural situation and compare the returns from milk with those from other farm products, when we also take into account the uncertainties connected with them and the regular demand for milk, — the outlook is in the main encouraging.

The CHAIRMAN. An opportunity will now be given for discussion on this most important subject, or for asking questions of the lecturer.

Mr. GEO. E. TAYLOR (of Shelburne). The question I would like to ask is this: If I understand the speaker aright, breeding for more milk produces a poorer quality, and I would ask if that necessarily follows.

Mr. WHITAKER. It does not necessarily follow, but the tendency is that way.

Mr. TAYLOR. Do you think, if due caution is exercised, that poor quality will follow?

Mr. WHITAKER. That is a question in breeding that I should hardly want to answer positively.

Secretary SESSIONS. I suppose what Mr. Whitaker means is that the farmers naturally turn to the cow that will give the most milk; they save the calves from the cows that give the most milk, and in a community where they sell milk they sell their Jersey cows. In my own community a man had a herd of cows. He made a bargain to sell his milk, and went to a neighbor and swapped his Jersey cows for those giving a larger quantity of milk, without regard to quality.

Mr. TAYLOR. You said that the average man or the farmer might, with the Babcock test, know just what he is doing. Do you think the average farmer is capable of running the Babcock test so that he will do the work accurately?

Mr. WHITAKER. There is no doubt he can do it with sufficient accuracy to satisfy himself whether his milk is up to the standard or not.

Mr. E. A. HARWOOD (of North Brookfield). You said the milk from the Brookfield car was above the average and the milk from the other car was below. I would ask if you would be willing to tell what car that was that ran below the standard.

Mr. Whitaker. I do not know as it would do any good for me to advertise a community unfavorably. I thought there would be no harm in advertising Brookfield favorably, for it carries out the fact I mentioned before, that individuality in cows has very largely to do with the quality of milk.

Mr. Harwood. We had a co-operative creamery in our town, and a great deal of the milk formerly went to the creamery. While we were comparing the work of the creamery with that of others in the State, we found that it ranked higher than some. Many farmers got it in their minds that there was something in their grass or soil that would make a better quality of milk than was made in some other sections. That was one thing I had in mind when I asked for the name of the place that sent in the inferior milk.

Mr. Chas. E. Ward (of Buckland). I live in a section where we are just changing from a creamery to selling milk, and our experience leads me to confirm one part of Mr. Whitaker's statement, and also backs up his claim for the milk standard. In our locality we were all butter farmers; but the milk car commenced to go through about two years ago, and now it is picking up quite a little milk, and I have noticed among our farmers an increased disposition to abandon all their former nice rich animals. I believe they would turn their cows into pumps unless there was some standard to keep them in check. The milk brought 19 cents per can at the station, and the farmers had to pay 2 cents per can to get it to the station, leaving them about 2 cents per quart. I do not suppose that they could afford to keep up the standard of Jersey cows and sell milk; but the tendency will be to go clear to the other extreme, unless there is legislation to keep it in check. One question I want to ask: I understood Mr. Whitaker to say that milk of to-day would not reach Boston until some time to-morrow.

Mr. Whitaker. You know better than I do about the loading of the car in your vicinity. In many cases a car that starts this morning would take the milk of last night and yesterday morning.

Mr. Ward. The car starts one hundred and twenty-six miles from Boston in the morning, taking the morning's milk and that of the night before. Some of our farmers have to get up and milk at from three to four o'clock in the morning; they get their milk into Boston on the same day that it is milked, between twelve and one o'clock. It is thus delivered in Boston the next day.

Secretary Sessions. Is that same practice pursued in not weather?

Mr. Ward. Yes, sir.

Professor Brooks (of Amherst). I believe that I am somewhat at a disadvantage in rising to speak on this subject, as I have not been following the whole line of argument of the speaker; but so far as I have been able to follow him, he is in favor of a standard substantially as it is at present, with the exception of the summer months, when he would have it still higher.

Mr. Whitaker. The exemption in favor of the summer months was a compromise to get the law through, any way, and is unscientific. It is just as easy to make 13 per cent solids in June as in July or August.

Professor Brooks. I think I should differ from Mr. Whitaker somewhat, for this fact, which I think is thoroughly substantiated; namely, that feed which stimulates a large yield always somewhat decreases the percentage of solids in milk. The exception of the summer months may not be exactly scientific, but the succulent grass which so large a portion of the cows get during the early part of the summer will make the percentage of solids somewhat lower. Something in the grass stimulates a much larger yield. I am in favor of some standard, but it does seem to me that the method of setting the standard or the principles of the standard might be improved. I believe, personally, in a standard expressed in two terms, — solids other than fat, and fat. I believe that the milk of the Holstein or of the Shorthorn is not simply as well suited but better suited as food for children and adults than the milk of the Jersey, and I think that medical men will agree with me, as a rule. Why, gentlemen, even the Jersey calf does better on Holstein milk than it does on Jersey milk. The standard as it stands to-day works against these breeds. Ayrshire milk, Holstein milk and Shorthorn milk are not simply as good food for children as the Jersey and Guernsey, but better. The Holstein and Ayrshire can be changed; they can be made in time, no doubt, to give milk of similar character to that given by the Guernsey or the Jersey. If my position is correct, why, then, you will certainly agree with me that it is undesirable to try to make Jerseys out of the Holstein and Ayrshire breeds. But if the standard be expressed in two terms, — solids other than fat, and fat, — then you would not necessarily discriminate against a Shorthorn to the same extent as you do at present. Fat is useful, of course, but there is such a thing as having too much. The percentage of solids other than fat in milk does not vary very widely. The Jersey will give 4 per cent or more of fat, and the total of solids in the milk is accordingly 13 per cent or thereabout. The Ayrshire or Holstein will give 3 or 3½ per cent, occasionally less, of fat, and that would not bring it up to 13 per cent solids. Of course it may be argued with reason that such a change in the law would increase the supply of milk, which is already too great, and therefore it would work against the farmers. I do not think that I am entirely in accord with the speaker concerning this point of the standard, or the difference of the standard in summer months compared with other months.

Mr. Whitaker. There is a great deal of force in what the gentleman has just said, and if his premises were accurate I should be inclined to agree with his conclusion. But, as I have studied the composition of milk, I have been led to believe that the average composition of the Jersey and Guernsey milk is in the neighborhood of 14 or 15 per cent of total solids, and the standard of 13 per cent represents the average of all breeds, perhaps excepting the Holstein. The law does not discriminate in favor of the Jerseys and Guernseys, for they are above the standard. It represents the average production of average cows of average breeds. As regards the exemption of May and June, I have much respect for the opinion of the professor, for he has studied this question, perhaps more experimentally than I have, my information having been more that of a compiler. A bulletin of the Vermont experiment station in 1891 says that feeding watery food does not make watery milk. The Wisconsin station found that inducing cows to drink immense quantities of water was followed by a reduction in the quality of the milk.

Mr. A. Bradley (of Lee). I was called into a neighboring town to give a little counsel in regard to the quality of milk. They were having trouble. This was in May or June. The feed in the pastures was very flush, and the milk standard was not reached by a good deal. It led me to infer at once that the feed had a great deal to do with the quantity of milk, and that in getting the quantity we did not get the quality. I find that in butter an increase in the milk does not correspondingly increase the quantity of butter. We can bring a cow to about such a point in butter, and by increasing the food increase the milk, but we do not get an increase of butter. How would you advise to feed, in order to get the quantity of milk and also keep the quality? There are times when there are unusual demands, and by feeding we can get the quantity but we do not get the quality. I have had milk tested at Amherst a great many times. I have sent the first two quarts of milk of the cow, the middle two quarts and the last two quarts. I found that the first two quarts was a little better than water, — only a very little, — while the middle milk was good and the last milk was very high in richness. The idea was suggested at once to take the first two quarts of milk and give it to the calves. We want to know how to feed, and get the quantity and quality at the same time. We want our whole dairy to go right into the market, and we want to hold the quality right along with the quantity.

Ex-Governor Hoard (of Wisconsin). Does not your proposition presuppose that all the cows were alike individually? Is not the solution of your proposition in the selection of better and richer cows, if you want to improve your milk?

Mr. Bradley. We have had experience with different cows. I find that Holstein milk meets just exactly the demands of cooking and for children; it holds its own; it goes into market in good condition, and all right; and you improve the quality to get it up to a higher cream standard, and it is not so valuable in any way except for butter.

Mr. C. L. Hartshorn (of Worcester). Would you do it through feeding, or breeding and selection of cows?

Mr. Bradley. In this town that I was speaking of I would state this fact: before the cows went into this May and June feed their milk was up to the standard, but afterwards it was below the standard. They said more grain failed to increase the quality.

Mr. Hartshorn. Mr. Bradley has suggested that the first two quarts of milk be fed to calves. Take the rest of that milk, — I want to know if he can tell how the milk would stand then.

Mr. Bradley. I stated that in the analysis of the first milk it was nearly all water.

Ex-Governor Hoard. In other words, you have been diluting your milk by keeping that first two quarts in.

Mr. Clark. I would like to ask if that first two quarts, in Mr. Bradley's opinion, would be beneficial to feed to calves.

Mr. Bradley. About as good as hay tea.

Adjourned at 12 m.

Afternoon Session.

The meeting was called together at 2.15, Mr. E. W. Wood presiding.

After songs by the Oberon Ladies' Quartette the chairman said: The subject of this afternoon's discussion covers the whole subject of dairying, including the raising and feeding of stock, its care and protection and the sale of dairy products. The subject as worded by the speaker is "The necessities and demands of modern dairying," and I have great pleasure in introducing Ex-Governor Hoard of Wisconsin.

Ex-Governor Hoard. When the Ladies' Quartette sang "Dixey" I thought we might change the word and say "I am going back to the old farm home" with equal propriety, for every heart, whether in the West, in Dixey or New England, can remember the sweet, hallowed effect of the old farm home; and in the interest of the old farm home we consider the questions we do in a convention like this.

THE NECESSITIES AND DEMANDS OF MODERN DAIRYING.

BY W. D. HOARD, FORT ATKINSON, WIS.

What a wonderful transforming power is the hope of financial gain! It is transforming the whole world mechanically, commercially, scientifically, and, as a consequence, politically. For the sake of gain the inmost secrets of nature are sought out, and the physical forces of all the earth are placed under contribution. Human intellect is stretched to its utmost tension to perceive the *truth* of material things, to know the laws that govern nature's forces, in order that man may have increased dominion over them. All this we call progress, and its main inspiration is the hope of financial gain.

It is a curious feature to me that the farmer, of all the various classes of society, should care less to make money, and for that reason should exhibit, so much less than other men, the mental activity and energy in its acquisition that they display.

We have been accustomed to say that the farmers are naturally conservative, and hence do not embrace opportunities for improvement in methods of gain-getting with the quick mental appreciation and avidity that other men do. I am convinced that conservatism is not the right definition. We should say rather that the farmer does not care to get rich, as other men do; that he has no such consuming desire for wealth and all it can buy as the manufacturer or merchant. It is fair also to say that, owing to the character of his environment, he cannot see the opportunities of reward for increased mentality and activity that present themselves to men in other vocations; and so he settles down to a resigned sort of contest with nature, believing that she will give him nothing except in return for a severe physical struggle. He forgets that he labors no harder to overcome nature than does the miner, the lumberman, the mechanic, the manufacturer; but somehow they come to their struggle with a keener zest for gain, with a deeper appreciation of the help of science, and a broader belief in the power of study, thought, knowledge, — in short, the power of mind over matter.

There was such a thing as old-time dairy practice. It was governed by the conditions and demands that then existed. It filled that demand very fairly, but it does not fit the necessities of to-day. There has been a great change. New conditions and demands have arisen. Why, the taste that governs the market in butter to-day is nothing like the taste that was in vogue thirty years ago.

The ever-present difficulty that we confront is, that there are so many of the farmers who keep cows who are anxious for profit, but who have not changed with the times. They are administering their business and shaping their practice to-day with the ideas and judgment that belonged to yesterday.

I am convinced that the only road out of our present difficulties as dairy farmers is to abandon a large proportion of the old-time notions we have concerning the conduct of our business, and look at it more in the light of modern necessities and demands. Let me enumerate some of these necessities: —

First. — More revenue. Our present civilization is more expensive than it was fifty years ago. It costs more to live decently and socially, and educate ourselves and children. An old man in my town got drunk and fell into the mud on the side of the curbstone, and commenced to shout, "Help, help," he said, "and an almighty sight of it, too." I would most candidly commend his prayer.

Second. — Increasing competition in the production of dairy products. Whole States have been added to the production of butter and cheese, and time and space have been almost annihilated by the wonderful march of intellect in railroad transportation. Wisconsin is nearer Boston to-day than was Vermont forty years ago.

Third. — Decreased fertility of our farms. You here in New England know painfully well what that means.

Fourth. — Increased cost of labor on the farm, as well as cost of feed.

Fifth. — The effect of adulteration, which has taken from the farmer an important part of the market demand.

Sixth. — The refusal of the market to take the product of crude, unskilful farm labor.

Seventh. — The rapidly increasing liability of loss in our dairy herds through the introduction of modern diseases.

Under the head of necessity No. 1 stands "more revenue." It is evident that we must make more money out of the business, unless, like many farmers, we are wholly discouraged at the prospect of gain, and so content ourselves to barely exist. But that will not do; that is a reproach to our intelligence and good sense. The price we are to get for our products is settled beyond our control. The market end of the string is not in our hands, except in the shading of quality we put in our goods. What, then, shall we do for necessity No. 1?

Decrease the cost of production. How? First, as to our own personality. We must become more intelligent concerning what are called "dairy principles." We must be willing to spend a little more time and money to fertilize our thought and judgment. It is as evident as the sun at midday that a very large proportion of the men who keep cows have a poor, unprofitable cow judgment. We must enlarge our ideas as to what a dairy cow means. Make ten cows do the work of twenty, if possible, and thereby make a profit on the keeping of ten.

The amount the average dairy farmer spends for the promotion of his dairy intelligence is too ridiculously small to mention. It does not average fifty cents a year. How can men expect to adequately provide for their growing necessities, when they are so unwilling to secure dairy knowledge whereby to secure a better dairy judgment? Are they making money with their old judgment? No! Are other men making a good deal more money by the use of a different judgment? Yes!

We must next reduce the cost of production by a wiser selection of our cows. The butter from a cow which produces only 150 pounds a year costs more than double that which is produced by a 300-pound cow. The first practical step in this cow question, then, should be to reduce the number of our cows and increase their capacity. That is our end of the string. We can control things somewhat, if we will, at that end. On how many farms can you see that end lying loose and neglected, and the farmer straining his eyes to look at the market end, over which he has so little control. How shall we increase capacity? First, by paying more attention to the laws of sound dairy breeding. Second, by striving to know more than we do about dairy feeding and management. How many men in this audience have provided themselves with a Babcock test? It requires but a small outlay, and it is the thing of all others to put *know* in place of *guess*. How many men here are really trying to make first-class students of dairy breeding? How many men here are readers and students of dairy literature on that and other questions?

Let us take a little evidence on this question: —

Mr. Geo. R. Sneath of San Francisco, Cal., who milks a herd, averaging 500 cows in number, for the market of that city, says, in a recent letter to "Hoard's Dairyman," "Our standard for a fairly good cow is 5,000 pounds of milk in eight months, or between calves. All below 3,000 pounds, except heifers with first calf, are discarded."

That man sets up a standard; that is the first thing to do. Establish a standard of performance on the part of your cows, then breed towards it, feed towards it, and keep the weeder constantly at work. It does not require a large herd; indeed, the man with a small herd can do more per cow than the dairyman with a large herd. There are a number of patrons of Hoard's creameries to-day with ten cows who are making double the profit, in a sum total, than other patrons who keep twenty cows. But the successful men have clear, definite ideas, and they work towards them.

Mr. Sneath further says: "Our business does not permit us to raise more than 125 calves annually, which will not fill up the ranks; therefore we purchase enough of the best cows we can find every year to make up the deficiency." Now, mark the following words and the judgment they convey: "but of these we have to discard 75 per cent to secure good milkers."

That statement will give us very fair judgment as to the number of the average cows in the country which will yield 5,000 pounds of milk annually. At the standard per cent of butter fat, viz., 4 per cent, that gives us only 200 pounds of butter per cow in one out of every four. The average of Massachusetts would hardly enable Mr. Sneath to put a cow in his herd, for the average of Massachusetts is only a little above 3,000 pounds.

One of my neighbors, a Mr. Merriman, who was a very successful handler of cows, informed me that he worked for six years in buying the best cows he could get for $40 each, to build up a herd that would yield 200 pounds per cow. It required the purchase of over 100 cows to secure a herd of 25 of this character.

I used to see men in the army that could handle a company of a hundred men, but go to pieces on a thousand; that could handle a thousand men, but go to pieces on a brigade; that could handle a brigade, but go to pieces on a corps; that could handle a corps, but could not command an army. God has set limits in your comprehension and power of handling men and also of handling dollars. Many a man can do a ten-thousand-dollar business who will go to pieces on twenty thousand dollars; and that one question of the limit applies as well in war, applies as well in dairying, applies as well in commerce. But it is a mighty good thing to find out what your limit is. The difficulty that I have noticed among men is, that they are satisfied not to find out what that limit is. It may be that it is a prophetic sense that they have, and they do not want to dispute it.

For a man to engage in a race for speed and to bestride a draught horse would be a proposition no more ridiculous than it would be for a man to engage in a contest for butter and take an animal that was bought for another purpose entirely.

The question was raised this morning, "What should people do to enrich the milk?" This comes back to the proposition of constructing a cow; and when a man commences midway in any proposition, he will find the proposition cuts a very important figure.

The Geneva Experiment Station in New York has been exploring the cow a good deal. Here are some of the facts they brought out in one exploration.

They wanted to get at the value of the milk solids, so as to have a reasonable basis to calculate from. They started with seven different breeds of cows. They figured the milk in gross worth $1.28 per 100 pounds, the milk solids worth 9⅓ cents a pound and the butter fat worth 26⅓ cents a pound. Starting with these figures as a basis of calculation, we find the first table to show the following results: —

BREED.	AVERAGE VALUE OF MILK.		
	With Milk at $1.28 per 100 Pounds.	With Milk Solids at 9 1-3 Cents per Pound.	With Milk Fat at 26 1-3 Cents per Pound.
American-Holderness,	$73 22	$67 58	$56 12
Ayrshire,	87 24	81 14	64 47
Devon,	51 00	53 89	48 27
Guernsey,	68 93	75 04	75 18
Holstein-Friesian,	101 35	87 41	70 07
Jersey,	64 58	72 37	74 30
Shorthorn,	72 50	80 85	72 03

If the milk were all counted at $1.28 per 100 pounds, the result is as we see it in the first column; but, if we take the value of the solids as a basis of value, we see a change at once. The American-Holderness cow drops down from $73.22 to $67.58; the Ayrshire, from $87.24 to $81.14; the Holstein-Friesian, from $101.35 to $87.41; while the Devon rises from $51 to $53.89; the Guernsey rises from $68.93 to $75.04; the Jersey rises from $64.58 to $72.37; and the Shorthorn rises from $72.50 to $80.85.

If we take the butter fat as a basis of value, at 26⅓ cents per pound, the Holderness drops to $56.12; the Ayrshire drops to $64.47 ; the Devon drops to $48.27 ; the Holstein drops to $70.07 ; the Shorthorn drops to $72.03 ; while the Guernsey rises to $75.18 and the Jersey rises to $74.30.

The figures show clearly how important it is that we value a cow's milk by the total solids or by the butter fat, whichever it is we are selling.

The next table is very interesting, in that it shows the relative value of these cows when placed at the business of butter making. The calculation is based on the actual butter made from each cow, and which sold at 25 cents per pound: —

BREED.	FAT.		BUTTER.			RESULT.	
	Average Fat Content of Milk.	Average Total Yield per Period.	Average Yield per Period (Calculated).	Milk required to make a Pound of Butter.	Cost of Food per Pound of Butter.	Value of Butter Product at 25 Cents per Pound.	Average Profit per Cow.
	Per Ct.	Lbs.	Lbs.	Lbs.	Cts.		
American-Holderness, . .	3.73	213.1	239.9	23.80	17.90	$59 98	$17 08
Ayrshire, ...	3.60	244.8	275.2	24.70	17.92	68 80	19 48
Devon, ...	4.60	183.8	208.4	19.15	18.00	52 10	14 58
Guernsey, ...	5.30	285.8	325.6	16.53	14.15	81 40	35 25
Holstein-Friesian, . . .	3.36	266.1	298.1	26.60	17.02	74 53	23 80
Jersey, ...	5.60	282.1	322.4	15.63	14.11	80 60	35 11
Shorthorn, ...	4.44	269.0	305.1	19.84	15.15	76 28	30 06

This table lets a lot of daylight on the value of those cows, supposing we employed them for butter making; also the food cost per pound of butter. It will be seen that the two butter breeds produce butter at the lowest food cost, the largest gross product per cow, the largest gross value of the butter at 25 cents per pound, and the largest profit per cow.

COMPETITION.

Our second necessity, that of competition, demands at our hands increase of quality and the placing only of fresh, fine goods on the market. In that way only can the New England dairyman hold his market. The old notion, once so much indulged in by Eastern butter makers, of holding the summer make in the cellar for fall and winter demand, is no longer of value. The freezing rooms in the Western mammoth cold-storage houses can turn out a much finer sample of June butter in December or January than any farm cellar. If you desire to hold your summer butter, send it to the cold-storage house in Boston, where it will be frozen down to eight degrees above zero, and held so until sold to the consumer. The charges per pound for storage will be light compared with the loss in the farm cellar.

Myself and son own a large cold-storage house in Fort Atkinson, in which we put butter in June and freeze it at once for January consumers. Our patrons pay at the Elgin price. We furnish the capital and put the butter into the storage, and hold it at eight, ten or twelve degrees above zero. Skill has sanctified every step, and hardly any one when that butter is taken out would know that it had been made a week. It is fine, and continues to be fine goods. It contains a large proportion of the original flavor of nice butter. Now you can see to what difficulties an ordinary farmer would be subjected when undertaking to hold butter and compete with fine goods, handled according to modern management.

DECREASE OF FERTILITY.

Decreased fertility of farms is one of the most discouraging of all the necessities we labor under. In order to make the most profit possible out of the cow, not only must she be a *good* cow, but we must raise her food as largely as possible. Summer droughts are making us tired all over the land. It is evident that our pasturage is beginning to be about the most expensive of all our methods of feeding. Never was the economy of the silo, both for summer as well as for winter use, and the growing of corn, peas and other soiling crops, better demonstrated than the past summer. We must at once grapple with the question of the summer silo. We must fill it in the fall for the next summer. We must learn that it is to be somewhat differently constructed, particularly as to shape, and if we are wise unto our future dairy salvation, we must make larger provision for summer soiling. This system will help greatly to make amends for decreased fertility, for in that way we can concentrate more cows on a given area of land. Let the rugged, barren hill pastures grow up to trees. They never should have been cleared, in the first place; timber is their most valuable crop.

Cost of Labor.

Necessity No. 4 has to do with the increased cost of labor as well as cost of feed. Right here will again come in the economy of better cow management. It practically costs no more to provide the labor for a 300-pound cow than for a 150-pound cow. The same economy applies to the matter of feed and cost of stable room. To put costly food into a cow, with the hope of getting 25-cent butter and lots of it, and then be obliged to take up with 3-cent beef, is not good economy, when we consider that the same food that will make a pound of dressed beef will make a pound of butter.

To win good success, the dairyman must study the principles that govern success. Chief among them is the cost of production, and all the different elements that enter into it. A farmer cannot do this successfully by shutting himself away from the experience of other men.

Adulteration.

The effect of adulteration has been to take from the farmer an important part of the market demand. On this question let us start with these premises. The farm is the only true source of human food. The farmer is the only rightful producer of that food. Any man who steps between the farmer and the consumer as a producer of food must do so as an imitator. An imitation is a counterfeit, and a counterfeit is intended to deceive, and is a fraud *per se*. The agricultural department at Washington, I am told, makes the estimate that from one-sixth to one-fourth of our food is adulterated. This is robbing the farmer of an important part of his market, and is a swindle on the consumer as well.

The Wisconsin Dairy and Food Commission took thirty samples of cream of tartar, and twenty-four out of the thirty did not contain a trace of cream of tartar. Does any one wonder that Bright's disease is on the increase, when you consider the increased work that the organs of the body have to do to eliminate the poisons that our own neglect and indifference allow the dishonest manufacturer to put into our daily food? These questions are said to be raised because the farmer is afraid of competition. Great Heavens! Does any one want to be poisoned in order to have competition?

There is only one remedy, — that of a united and willing co-operation on the part of the farmers to establish laws and enforce their execution against this unpatriotic and fraudulent traffic. The farmer should not fall back on old-time ideas and methods to meet this difficulty.

Our fathers knew nothing of this modern devil. How shall he be cast out of the temple? He has taken up his abode in the swine, like his ancestor in the time of our Saviour, and now devil, hog and all walk into the market and propose to masquerade butter out of its rights as an honest proposition. Butter cannot masquerade; it never poses for something else than butter. It always advertises its true quality, and there is no mistaking its flavor, good or bad. For this reason the consumer need never be deceived as to the true character of butter. Think of that a moment. It never poses for something else than butter. It always advertises its true quality, and there is no mistaking its flavor, good or bad. It is God's proposition, and nobody is ever deceived thereby. It never was compounded by man; all he did was to separate it from the milk. It is a proposition direct from the Maker himself. It was constructed for food.

Here again must the farmer be a man of to-day, must put himself into the co-operative ranks, where he can be counted for his own defence. You here in Massachusetts have set a splendid example to all the world. Your best citizens of all classes have united and fought this question through the highest courts to a triumphant finish. You established law, but that is not execution. Execution will come from the tone of public opinion, and that tone must be constantly stimulated and supported by a live, active public sentiment among the farmers. I believe that such an example as that of Massachusetts cannot be quoted in the world. With an agricultural population of only one hundred and fifty thousand out of a total population of two millions and a half, you set an example to the whole world in the contention for pure food. Here again must we conform to modern necessities.

Skill is demanded.

The refusal of the market to take the product of crude, unskilful farm labor is of immense application in dairying. It is very difficult to make some farmers see why, if they work hard, their labor should not be rewarded by the best price in the market. It is almost impossible to get them to see that, in dairy products in particular, the market is not paying good prices for hard labor, but rather for *skill.*

Fine butter is the product of fine skill. The cows must be fed, managed and stabled with skill; the milk must be handled with skill; the butter must be made with skill; and when all that is done, commercial skill must step in and dispose of the product. That is the modern demand of the market. Such is the necessity of modern dairying.

He that is intelligent enough to perceive these necessities and these demands,. and has energy enough to conform to their unyielding logic, is wise indeed. But he will never get this wisdom by keeping his mind shut away from the current of dairy thought and discussion.

Liability to Disease.

The demands of modern dairying have produced the modern dairy cow, but they have not produced adequate sanitary judgment and knowledge for her protection on the part of her owner. We are still housing and handling this modern cow amid all the increased danger that has come from our indifference, with scarcely any change in methods from those which obtained thirty or forty years ago. I believe that 75 per cent of the stables in New England are of the same pattern they were forty years ago. I do not believe the dairy cow is any more liable than the beef cow to tuberculosis, pleuro-pneumonia or any infectious disease.

The tendency to these diseases among our dairy herds is not because they are Jerseys, Guernseys, Holsteins or Ayrshires, or because they are dairy cattle in general. The dairy constitution is just as resistant as is the beef constitution. The investigations by the Canadian government and the Minnesota Experiment Station prove this. The cause lies, I believe, in our own lack of good sanitary judgment. All infections thrive best among large aggregations of men and animals. We have crowded our dark, foul, unventilated stables with too many cows. We have been stingy of room and sunlight, and prodigal of life and health.

The demands of modern sanitary science will teach us better if we are not wrapped too closely in the mummy-cloth of old notions and prejudices. It is said that Raphael was once asked to give in a single sentence a true definition of art. His answer was, "The ability to see." Unless the mind's eye can see the picture clearly and truly, the hand will never paint it.

This is just as true of the art of dairying as of the art of painting. The great difficulty everywhere with the farmer is to get him to see dairy truth. The ability and the disposition to do will follow quickly after. His first effort, then, should be to give himself more opportunity to see dairy truths in the light of modern necessities and demands.

The CHAIRMAN. An opportunity will now be given for discussion, or for asking questions of the lecturer.

Mr. G. M. WHITAKER (of Boston). I would like to have the lecturer state his opinion as to the importance of valuing a cow's milk by the total solids contained in it, rather than by the number of quarts.

Ex-Governor HOARD. I look upon that question just as I do upon the coinage question. I am not a sixteen-to-one man. I believe in the valuing of milk by the solids it contains, not only for the reason that it is more just, but because I want to see every condition of dairy work made a radical call for another step. I believe it is a proposition founded on true, intelligent justice, and of larger profit in the future. A cow should be valued according to the amount of solids she gives. That does not say that I am in favor of one breed more than another. A cow may give you the same amount of solids in 50 pounds of milk as in 20 pounds of milk, but, if she does, should you sell that milk for as much per quart?

Mr. H. A. BARTON (of Dalton). There are with us a good many patrons of co-operative creameries. I understand that the creameries in this section are almost entirely carried on under the cream-gathering system, and counting the cream by spaces. I would like to have Governor Hoard explain the mode of paying for this cream according to the amount of butter fat which is contained in the cream.

Ex-Governor HOARD. It is the same as though you tested the cream in place of the milk.

Mr. BARTON. I understand that, but I would like to have the governor explain the mode of procedure in carrying on the test.

Ex-Governor HOARD. You simply test the cream, just as you do the milk in the Babcock test.

Secretary SESSIONS. I think Mr. Barton wishes to know how you keep the cream of the patrons separate.

Ex-Governor HOARD. I do not know of any other way, if you force yourself to do business in that way, than to take a sample of each patron's cream, and go around with a full equipment to take samples and test them. If the patrons brought the cream to you, they would leave samples, wouldn't they? If a patron brought milk, he would leave a sample of the whole. We use this system in the West very little, and then only where the population is so sparse and widely distributed that it is not economical to carry milk. In the East, where you have a dense cow population, in my estimation a much more economical proposition would be to bring the milk and take the skim-milk back home. Or you can establish, if you choose, skimming stations, where the farmer takes his milk to the station, has it tested by the Babcock test and the cream shipped to the central churning station. It may be that your method is the best, but it does not appear clear to me yet that it is the most profitable or economical.

Mr. PRATT (of North Middleborough). Will the governor explain Western methods?

Ex-Governor HOARD. There are two methods of conducting creameries in the West, — by gathering cream and gathering milk. In Dakota the creameries nearly all gather the cream. The farmer separates it by cold setting or any method he wishes, and it is credited to him as to its butter-fat value by the Babcock test. Then he is given credit for whatever fat he contributes.

In my section in Wisconsin, where we have a very dense cow population, where we have in our county seventy-nine creameries and four cheese factories, the milk is taken to the factory by the farmer in the morning, which includes the milk of the evening before and morning milk, each of which is kept separate. The farmer takes the amount of skim-milk due him back to his home, and goes on with his work. This is done every morning. Sometimes the farmers on a given route unite, and the one living the longest distance away takes a contract from each farmer between him and the creamery to haul the milk at so much per cow for the season. He starts in the morning and puts his own milk into the wagon and goes to his next neighbor, who has his milk ready on the platform, and the next neighbor, and so on. Each man's cans are marked, and when he arrives at the creamery he has the milk of ten or twelve farmers on his wagon. Samples are taken and tested, and the tests will be declared the next morning. It is not usually economical to carry milk more than three or four miles. If it is necessary to go farther, other creameries are established. To-day the sample is taken, to-morrow the test is declared. Each man's milk is not tested every day. Samples are taken every day, and may be tested once in three days or a week. The man who brings the milk takes the skim-milk back to each man in his respective cans, and puts the cans back on the stand he took them from in the morning, and rounds up at his own home, usually about noon. He devotes half a day to this work. It is more economical for the farthest man to do it, for the reason that it requires but one journey.

I will give you our own system. We agree to pay the farmers the Elgin price of butter — the highest wholesale price in the United States — for their milk, less 4 cents a pound for making, caring for it, selling it and packing it, — the whole expense connected with the business, — and at the end of each month, whether it is sold or not, we pay them in cash at the average price of Elgin for that thirty days. And so on goes the system round and round. Last year we paid to the farmers, in an area of about eight or ten miles, $300,000; we made over a million pounds of butter. Almost every patron is a German, seventy per cent at least. These men are splendid patrons when you get their confidence, and you must be careful to hold it. Integrity is the foundation of confidence with the German, for he never forgets. If they are dealt with fairly and squarely, they stay by you; and in this manner we produced in our county last year about two and one-fourth million dollars' worth from our cows. That is our system.

Mr. Pratt. In our section we are told to place our milk in the Cooley creamer as soon as possible after drawing from the cow. Is the quality of the butter different when the milk is cared for after your system than it is when it is immediately set in the Cooley creamer?

Ex-Governor Hoard. I think we have less trouble than you do, where you set milk for twenty-four hours in the Cooley creamer. If there is any impurity in your milk it stays there and soaks for twenty-four hours, whereas with us it is separated soon after being drawn from the cows.

Mr. Pratt. I can certainly see one great advantage in your system, — you get clear of the expense of ice, which is quite an expense in our county.

Ex-Governor Hoard. Another thing. The milk is separated from the cream and the cream is gotten into the creamery as soon as possible from the farm. Under this system of centrifugal separation there is no multiplication of bad effects. For instance, we know that many farmers are careless about the keeping of their cows in winter. You look at their cows, and you see how filthy they are. It is almost impossible to make good milk from them. They will not stable their cows in a manner to keep them clean. If that milk is kept in all that stable dirt and dust that gets into it for twenty-four hours and soaks away in it, isn't it a good deal worse than it would be if separated within an hour or two after being milked? The night's milk stands only from the time of milking until the next morning.

Dr. Lindsey (of Amherst). You stated that you settle with the farmer according to the price of the Elgin butter, less 4 cents per pound for making, etc. A patron furnishes you, say, 100 pounds of butter fat in his milk. How many pounds do you pay for?

Ex-Governor Hoard. We pay for all there is. He furnishes the butter fat, and we furnish the water and salt; and we pay him for the water and salt, after having bought it ourselves. We weigh the butter that is made every day.

Dr. Lindsey. How do you apportion it? What is your estimate of butter that 100 pounds of butter fat will make?

Ex-Governor Hoard. First reckon the pounds of butter you have made, the pounds of butter fat you have received; divide the butter by the butter fat, and that gives every man his ratio or representative unit, by which you can multiply; then multiply each man by that ratio, and you have it.

Mr. M. I. Wheeler (of Great Barrington). The question asked by Mr. Barton has been thoroughly and successfully answered right here in Berkshire County. The Egremont Co-operative Creamery started six or eight years ago on the Cooley system, and paid the patrons by counting the spaces until about a year ago, when they adopted the Babcock test. It is a very simple and satisfactory operation to carry it on under that plan. The cream gatherer comes around as usual and weighs the cream of each patron and mixes it thoroughly, and then takes a sample. The samples are kept in a case of small bottles which he carries with him in his pocket, and when he gets to the creamery they are left with the butter maker and are tested,—not every day, that is, not every patron's every day, but some of them every day. Each patron's cream is tested two or three times a week, and the net returns for the month are apportioned according to the Babcock test, and it has worked very satisfactorily. Of course some men get more when the spaces are counted, and some less. The longer the milk has stood, the less cream in bulk and the less number of spaces. The cream of the first patron the cream gatherer came to in the morning had been set the shortest time, and would necessarily have a greater bulk of cream and be inferior in quality to that set several hours longer. This method does away with that objection, and has worked the past year to the perfect satisfaction of the patrons.

Mr. S. A. Hickox (of South Williamstown). The governor advised that we use ensilage for summer food for our cows. The thought struck me very favorably. I believe the governor is right on that point, but I wish he would first get the farmers of Massachusetts ready to raise ensilage for their winter food. I believe it is a problem yet to be solved, how the Massachusetts farmer shall carry his herds through the long, severe winter that we are subject to. The price obtained for hay on the market is robbing the farmers of the fertility that they so much need. They sell the hay because they can get more ready money than they can to put it through the cow, the machine they keep to convert it into dairy product, and then compare the dairy product with what they get for the crude material on the market. They say they can get the money easier through the system of selling hay. Do we consider what we sell when we sell hay? I wish the farmers would look at the experiment station reports, and see how much plant food they have sold in a ton of hay. I believe this point is worth consideration.

Mr. Bancroft (of Ellington, Conn.). There is one point I wish to emphasize, and that is, the keeping of so many dairy cows that are unprofitable. It is estimated that one-third of all the cows in New England are kept at a loss, one-third pay cost of keeping and the last third pay a profit. We must produce our food at the least possible expense. As a representative of one of the largest creameries in New England, the Ellington Creamery, I want to say that we have adopted the use of ensilage. We have put in quite a number of large silos. We are furnishing our cows with their food at from one-third to one-half less expense than before, and the quality of the product has not been diminished in the least. I have made experiments, and find that ensilage makes an exceedingly fine quality of butter. It is like June butter at all times of the year. We have found it to be successful, and I would recommend it to any farmer who wants to make dairying profitable. We estimate that the value of a ton of hay which will bring $15 in the market can be produced in ensilage for from $5 to $10. This has been proved time and time again.

Mr. C. M. Bull (of Springfield). I would like to ask the governor how long he has been operating under the Babcock test?

Ex-Governor Hoard. Since 1891.

Mr. Bull. Do you find that the per cent of fat increases?

Ex-Governor Hoard. Yes.

Mr. Bull. Do you find that there is any perceptible difference in the amount of fat contained in the cream in the months of May and June?

Ex-Governor Hoard. Not so much then, because so large a number of the farmers are alike in their methods of feeding at that time.

Mr. Bull. Do you have rules under which you ask your patrons to feed?

Ex-Governor Hoard. We get along with as few rules as possible. We enforce quality by saying "We cannot take that milk."

Mr. Bull. What is the extreme in the per cent of fat?

Ex-Governor Hoard. I do not think I understand your question.

Mr. Bull. I mean what is your lowest per cent?

Ex-Governor Hoard. We do not bar out any man even if he brings us milk that furnishes only 2 per cent of fat. His milk is received, because he is paid according to the deeds done in the body. He gets no more accordingly than if he brings 6 per cent milk.

Mr. Bull. Is 6 per cent very high?

Ex-Governor Hoard. Yes, it is a high average.

Mr. Bull. Is 3 per cent low?

Ex-Governor Hoard. Yes. Our average per cent for the year is about 4.60. I will tell you what effect it had on our community when we established the Babcock test. We had been taking tests of the milk from 1887 to 1891. We knew what the milk was worth in butter fat, but the dividends were apportioned on the pound plan. We commenced in April, 1891, to use the Babcock test. The average fat content of our milk from 1889 to 1891 was 3.97 per cent. The average fat content of it from that time on has been 4.30, 4.40, 4.50 and 4.60. The practical effect on the farmer has been at once to put him on the merits of the proposition.

Dr. Lindsey. I recognize the fact that we have the governor here for a purpose, and we should utilize him, but I feel that I should make a mistake if I did not add my word. When our friend Mr. Barton asked the governor to explain the difference between his system of paying for milk and cream and contrast it with the present system used by the Massachusetts farmer, I think he had the idea in view to show the farmers, if possible, which was the more beneficial, paying for cream by space or paying by the Babcock test. Now, we in Massachusetts at our station have been preaching for several years that the space was a delusion to the farmer. We do not claim to have originated that idea; we simply attempted to emphasize it. Two years ago a pamphlet was published in which the per cent of butter fat contained in the cream gathered from one hundred and sixty-five different farms was given. I took occasion to collect every sample myself, so I should know every condition. I found that that cream varied from 11 to 22 per cent of butter fat. The farmers were being paid the same amount of money per space, whether the cream contained 11, 16, 18, 20 or 22 per cent of butter fat, and I have been attempting to preach the fallacy of that idea ever since. I know that the seed has been sown and that in time it is going to spring up and bring forth fruit; but I must confess that it seems to me that the farmers are a little slow in taking hold of the idea, and I felt as though I must make that point emphatic in this public meeting, where we have so many interested in this line of work.

Professor BROOKS (of Amherst). I would like Mr. Wheeler to explain whether this gathering system has materially increased the cost. He says that he is satisfied to change from the old to the new. I think that the farmers of Massachusetts think it costs more than it is worth.

Mr. WHEELER. It does not add materially to the cost. It is no more trouble for the cream gatherers. They are paid no more, they are paid by the day. From 600 to 1,000 pounds of butter are made there in a day. The butter maker makes the tests at the factory. I really do not know whether he is paid any more for that work. Very likely he is, a little something, but immaterial in the aggregate.

Mr. WHITAKER. Our Massachusetts milk standard is 13 per cent of total solids, but in May and June there is an exception, when the standard is only 12 per cent. That exception is partly due to compromise in the Legislature, in order to get what we wanted, and partly due to the feeling in the community that when cows are first turned out on spring feed they will give milk not quite so rich. In answering Mr. Bull's question you have stated that there is no practical difference in May and June.

Ex-Governor HOARD. No practical difference between the several patrons.

Mr. WHITAKER. Do you find the quality very much diminished in May and June?

Ex-Governor HOARD. Yes, for the reason that a sufficient number of cows are fresh to affect the general average.

Mr. WHITAKER. Suppose the farmers should produce milk the year round, and have about the same number of cows fresh all the year.

Ex-Governor HOARD. That is an unsupposable proposition. The fact is that with too large a per cent of the farmers the cows are coming fresh in the spring when they ought to be in the stripper period.

Mr. WHITAKER. We find that there are times during July and August when it is more difficult to get milk up to the standard than in May or June. Two theories are advanced: first, that the milk is slightly adulterated, and the other theory is that the climatic conditions reduce the quality.

Ex-Governor HOARD. I can only give you my theory. I never could get into the inside of a cow yet. I know it is a fact that the same amount of milk will not make the same amount of cheese in a drought period in August that it will before that period, or, if rains come, after that drought period. If the milk is deficient in solids, it may be due to the fresh calving of the cow, to the flies or the hot weather, or, again, the feed may be deficient in nutrition. The answer is made by the cows to all these conditions, for they are very sensitive to unfavorable conditions.

Secretary SESSIONS. Worriment of a cow will affect the quality of the milk as well as the quantity.

Ex-Governor HOARD. Yes, sir. I have satisfied myself, but I cannot satisfy everybody. When I put out in 1886 what is known as "Hoard's Nervous Theory," it was received with derision, and in Europe they went at me in great shape. I spoke wiser than I knew, and men are beginning to think that it is a very important question. For example, take a cow that loved me as a lover would. She was as affectionate and pretty as could be. She would follow me around; there was a sort of a sweetheart arrangement between us; we delighted in each other's company. I wanted to know what effect it would have upon the quality of the milk to hurt her. I shut my eyes to humanity and proceeded in the light of science to find out. When I had her about half milked I took a sample of her milk and set it down and proceeded to milk again, when I took out a heavy pin and gave her a scratch across her flank. She bellowed with the hurt and turned and looked at me. She could not believe that I did it. She was full of fear and trembled with excitement. As soon as I could I commenced milking her again, and took another sample. Why was it that the last sample of milk contained 15 per cent less fat than the first? I cannot understand these things. I am only telling you what I did. Every mother in the land knows the effect upon her own babe of her own pain and mental disturbance. A mother should not allow herself to be thrown into a severe fit of angry passion, on account of some poisonous quality or effect which is given to her milk by these very conditions of nervous excitement. When we are using our cows according to the doctrine of kindness, we are simply doing good things for ourselves.

Mr. Bull. It is my opinion that we receive at our creamery from one hundred and fifty different dairies quite as good a quality, if not better, in May and June than we do in August.

Ex-Governor Hoard. I do not doubt you. Do you receive as good as in October, November and December?

Mr. Bull. While the cows are in the stable, no. The farmers that supply us must necessarily keep up as nearly as they can to a uniform supply, and avoid, if possible, the surplus of May and June, so consequently we get a more uniform quality of milk.

Ex-Governor Hoard. Do your cows mostly come fresh in the fall?

Mr. Bull. No, I think they are about evenly divided.

Secretary Sessions. The aim is to have so many each month during the year.

Mr. Bull. Yes, sir. We buy our cream by the Babcock test. Before I met the governor I was buying by the space plan. I became convinced at Great Barrington that if we were going to purchase cream we must purchase it by the Babcock plan. It took a great deal of effort to get the farmers to agree to try it, but I think I can say to-day without hesitation that they are satisfied that it is the only right and proper way to sell cream. As an illustration: I was at the Chester Creamery. We were making some tests. One sample showed 14 per cent fat. I thought that was exceptionally low, but on the same route another sample showed 27. That was, I thought, unusual. I began to feel that something was severely wrong. The gatherer came in on that day. I had saved the samples and repeated the test, and found that they came out the same on the second trial. I asked him to explain, if he could, why this should happen so. These were from patrons who had commenced to send their cream only this last month. He told me that in the case of the 14 per cent the gentleman did not care anything about whether he sold cream or skim-milk. Said he was disinterested, and did not care particularly about encouraging the cream business, and that he had been told all along that he would be disappointed if he expected to get any great returns from the bulk he was sending in. The other man, he said, is setting his cream in a shallow vessel of some sort by open setting. I felt better immediately; I felt that I was doing neither an injustice.

Mr. W. M. Tucker (of Monson). At what temperature would you keep a stable during the winter? What effect has sunlight on the milk?

Ex-Governor Hoard. On the question of temperature, I would arrange to have it somewhere about fifty degrees. That is a fair average of temperature for the keeping of cows in a stable, but I would be more anxious as to the character of the air than as to its temperature. Foul air is as frequently found in cold temperature as in hot. As a rule, the better air is at the top. As to the effect of sunlight, it is of immense importance to our cows. Not only does it affect the color of the butter, the color of the milk, but it is one of the most important sanitary agents connected with our stable life, and I do not understand why it does take so much talk to get the ordinary farmer to put a few windows in his cow stable. You will see hundreds and thousands of underground stables, with a little window here and there. A man with ordinary eyesight cannot see to read large type in the stables, and the cows are kept there all winter long. Any man's stable ought to have as much sunlight as his house. It is cheap. He could make a double window to guard against cold. You must warm the stables with the heat of the cows' bodies. If you want to fatten veal for the market and make a white veal, you must put the calf in the dark and keep him in the dark. If you want your cow to give white butter and white milk, you must keep her in the dark; and if you want her to give yellow butter and yellow milk, she must have the sunlight.

It is a wonderful disinfectant. I expect to preach from now until I die that sunlight and land plaster must be found in our stables. I wish you could see, as I have seen, the average tone of cows come up, where farmers have let in more sunlight, and used land plaster in the stable to absorb the ammoniacal gases and exhalations that arise.

Mr. TUCKER. I would like to ask how you would water your cows, — whether you would turn them out of doors, or keep them in the stable, in fairly cold weather; whether you think it would be better to have a trough of running water, or have it in the stable.

Ex-Governor HOARD. The object is to keep the cow just as much in a favorable condition for profitable production as you can. "Go to the ant" and learn of her wisdom. The ants are the finest dairymen in the world. They keep a lot of cow insects, and the delicacy and care with which they handle these little insects is wonderful. They not only handle them very carefully, but they are careful not to promote too much exercise. When a cow is milked, it is a strain on her nervous machinery, and she does not need exercise in the same way that an animal not in the function of maternity needs it. Consequently I would secure for her pure water not contaminated by any contact with other animals, and I would give it to her in her stable whenever she wants it. I would so arrange my stables that they would be on the south side of the barn, and I would turn the cow in the exercise of maternity out in the sunlight, but the very moment it became uncomfortable for that cow I would put her in the stable. I would watch her and promote her comfort, because she is making my money for me. I cannot afford to be negligent of her.

Mr. HICKOX. Does not the individuality of the cow have quite a little to do with the color of the butter?

Ex-Governor HOARD. Yes; the Guernsey cow makes the highest-colored butter.

Mr. HICKOX. I did not want you to leave a misleading idea in regard to putting the cow in the dark.

Ex-Governor HOARD. But a Guernsey cow makes butter which is more yellow in June than that made in January;

therefore I was correct in speaking of the modifying effect of the sunlight. A Jersey gives milk which is much more yellow than that of the Holstein, and in winter time we are obliged to give even Jersey butter a certain amount of color, in order to suit the market. We use scarcely any color in June and July.

Mr. WHITAKER. The Dairy Bureau has had butter brought to its attention for analysis from dealers in Boston. They were under a little suspicion as to whether it was process butter, or not. An analysis of it has shown that it was honest butter. There was every indication that it was the product of the udder of a cow. Can you tell us about process butter?

Ex-Governor HOARD. A man goes to work and buys all the job dairy butter he can, and reduces it to butter oil. He then clarifies it by heat, skims off the impurities and mixes it with milk, and by an infusing process incorporates that butter fat with the milk. He runs that same milk and butter fat through a separator, and forms the same as original cream. He then ripens that cream and churns it, and makes a process butter. I think that is the kind of butter you alluded to.

QUESTION. What is the average per cent of moisture in butter?

Ex-Governor HOARD. We make butter with about 16 per cent of moisture. If we were to put our butter into the freezing process, we would add about 20. Be very careful as to the character of the moisture. We have artesian water in our creamery. Secure water that is free from organic matter. We have about four thousand private customers whom we furnish with butter. It is delivered at their doors, and it must be butter that will not shrink too much in weight that will suit them. We cater just as much as possible to what the taste and judgment of the customers demand.

Professor BROOKS. I would like to inquire of the governor if he would recommend de-horning cows.

Ex-Governor HOARD. No more than I would de-tailing them.

Question. Does using hard or soft water make any difference?

Ex-Governor Hoard. Hard water always contains lime. I never could see any difference. We have a creamery that uses soft water almost entirely, and another that uses hard water, and I do not see any difference in the quality of the butter.

Mr. Bull. Does heating the drinking water of cows increase the flow of milk?

Ex-Governor Hoard. An excellent thing to do is to give a cow warm water. I will illustrate in this way. My wife taught me more about this question of how to handle maternity than any other being on earth. If men would consult their wives more, they would know more, particularly about things that a woman knows. I was riding with my wife when she was nursing our youngest son, a sturdy, lusty fellow (he came fairly by it), and he was calling on her for more than she had to give him. She was delicate, and felt very chilly. Mother-like, she said, "I am so sorry I have taken this chill." My curiosity was aroused, and I said, "Why do you say this?" "It means less for the baby," she said. "A chill means less for the baby, does it? What will you do?" She turned upon me and said, "You ought to know." "I suppose so." I suppose a man ought to know a heap, but sometimes he does not. "What will you do to restore your condition, which is at present unfavorable for the child?" "I will try to restore bodily heat, and take warm drinks." That was twenty-seven or twenty-eight years ago. "Well," I said, "warm drinks." Out I went to the barn and turned my little Jersey cow out in the freezing cold, and I let her stand there until her thighs were shaking. Many of you know what that means, when you bring a cow in from drinking ice-cold water from the brook. I noted the effect on her. I exposed her on purpose. Then I gave her warm drinks, and I kept experimenting with her. It passed on two or three years, and then I came out with a great deal of confidence, and said I had discovered something. I thought I was mighty smart, but when I came to look it up, there was not an old woman in the land but who knew all about it. I think I was among the first to advocate giving warm water to cows. If I were making milk in the winter, I would never give my cows water below seventy degrees.

Mr. BULL. If it stimulates the product, does it decrease the amount of solids?

Ex-Governor HOARD. Not the daily amount of solids. A cow gives about so much of the solids in a normal condition in a day. If you increase the amount of watery contents of the milk the per cent may be a little less, but the daily amount remains the same.

Mr. WHITAKER. It would reduce the fat per cent of the milk.

Ex-Governor HOARD. I think it might.

Mr. WHITAKER. Is there a possibility of feeding cows with concentrated food to increase the fat?

Ex-Governor HOARD. Yes, provided the cow has not been brought up to her normal production; but if she has been brought up to her limit of fat per cent, it is a pretty hard thing, in my mind, to increase the per cent of her butter production. If she has not been brought up to it, she may be raised to it. Cows that have a large limit have been made to produce an enormous amount of butter, and men have said that you could do wonders with food; but the capacity was put into the cow before they attempted to increase her product. With the theory that you can create butter fat one way or another by feeding, you could make a Jersey out of a Holstein, or *vice versa*, as you chose. Little "Jay I See" trots a mile in 2.10 on twelve quarts of oats. That is the speed product of twelve quarts of oats when put into "Jay I See." To get that amount of speed out of some horses I have owned it would take over ten tons of oats, then you would not get it.

Mr. C. B. LYMAN (of Southampton). By milking cows three times a day, will you get more butter fat than by milking twice a day?

Ex-Governor HOARD. I think so, but not enough to pay the expense.

Mr. LYMAN. Once I wanted to take my cows to a fair, and I milked them at noon, and I did not get more than half the amount of milk, and I supposed that I should lose half the butter product of the cows. Come to skim that milk, I found, to my surprise, that I got as much cream, or nearly as much, as I would if I had let them go until night.

Ex-Governor HOARD. There is one thing I want to say to all students of the cow. A cow that gives you rich milk, very rich milk, is correspondingly more liable to garget and disease of the udder, more liable to danger from blows, hurts of any kind. A clear indication of a cow that gives rich milk is the construction of the udder. If you have a cow giving very rich milk, be exceedingly careful that she is not exposed by lying on the cold ground in the fall of the year. If you are looking for a cow that gives thin milk, look for a cow that milks down to a thin udder which has less cellular formation.

Mr. STETSON. Do you think quicklime is a disinfectant? Will it take the place of land plaster?

Ex-Governor HOARD. No, sir. It is an excellent absorbent of moisture, but you need to save the ammonia in your stable. You go to New York and pay 16 cents per pound or thereabouts for it. That ammonia in your stable is worth to you all that you would have to pay for it. Land plaster is an excellent absorbent of this form of nitrogen. You need that on your soils, and you want your stables clean and free from the irritating effects of ammonia on the lungs of your cows and horses.

Mr. STETSON. How much land plaster do you use per cow?

Ex-Governor HOARD. I use about a barrel of land plaster to nine animals each three months. It costs me $1.60 per barrel. It is worth more than it costs as fertilizer. It is also an excellent thing on stable floors; it prevents them from becoming slippery.

Mr. J. C. NEWHALL (of Conway). We have a great deal of milk fever in our section.

Ex-Governor HOARD. I have lost but one cow from milk fever, and then I was off playing politics with the State of Wisconsin.

Mr. Newhall. Can you tell what is the best treatment for this disease?

Ex-Governor Hoard. I have no faith in curing it, but I do know something about preventing it. For two, three or four weeks before she becomes fresh, I am very careful to promote a lax state of the bowels, and after parturition I am very careful to keep her quiet and not have any cold draughts on her. Fever comes first with a chill, and if I can prevent the chill I can prevent the fever.

Adjourned at 5 p.m.

Evening Session.

The evening session was opened at 7.30 o'clock, by Mr. W. B. Barton of Dalton, president of the Berkshire Agricultural Society. After several songs by the Oberon Ladies' Quartette, the chairman in a few well-chosen words introduced as the speaker of the evening Mrs. Alonzo Towle of Freedom, N. H., whose subject was "The ethics of books."

THE ETHICS OF BOOKS.

BY MRS. ALONZO TOWLE, FREEDOM, N. H.

In the country home, upon the farm especially, the most significant lack is the varied converse of congenial friends. "Nobody to come in, no place of interest to visit, nothing going on," is a quotation from scores. Yet just at hand are friends innumerable, who will talk as much and as often as we like, in words most proper, upon any subject we choose. Clergymen, philosophers, statesmen, scientists and poets are waiting to hold familiar discourse with every soul upon these New England hills; not idle, casual chatter, but studied, finished and wisest instruction. Those who have recognized and utilized the companionship as found in choice books have received their best, truest and most helpful friends; for we must rise to their level if we enter into their spirit, as they cannot, like our personal friends, descend to us. In this way books are among our very best means of discipline, as well as culture.

It is far better to talk with great thinkers and reformers than to spend our time gossiping even with our next-door neighbor. The true ethical benefit of reading lies then not only in the help to an every-day upward rising of soul and mind, but in strengthening our powers in the direction of making ourselves useful. If we wish truly to know ourselves, we can in no surer way ascertain the facts than by giving attention to the kind of books which give us the most enjoyment and satisfaction. If dissatisfied with the results of our investigation, then good courage must be preserved until by force of habit taste for the best has been cultivated and established. We must have a healthy mentality, if we succeed in anything. As a help in this direction is the hope of something better to be accomplished in the future. Perhaps what we expect to do or be is the power of life; we are sure it is in a way the motor to all energetic and helpful lives. To the milder soul who does not have this kind of ambition may always come the desire not to allow life to get monotonous, but to keep alive the fire of life by either the grasping of new thoughts or by reviving old ideas.

It is not in these matters a question of few talents, or many. A few talents improved are better than many unimproved. The average person is by far the most numerous sort; those who go beyond and those who fall short of the average are the exceptions. Neither is it a question of belonging to this class, or that. Great literary productions have not most frequently been produced by those in high stations. There is nothing to hinder any one, then, from doing any work he or she is capable of doing in this line, and good literature adapted to all may be had for the seeking. A good book costs no more than a bad one.

General reading is not study; systematic reading, for some special object, is the student's method. In my judgment, it is the most successful and safest mode of procedure. Method helps and insures accuracy. To be accurate is to be educated in a sense. When once accuracy is established, then everything we read is for our best purpose.

By system we mean this: if we wish to know England's past and present condition, we read continuously its social, political and religious histories, its intellectual development and all its relations to other nations. Take up its literature by reading Shakespeare, Milton, Bacon, Macaulay, Carlisle and Ruskin. In the lighter literature Dickens gives a good idea of the lower English classes. Thackeray portrays the higher classes and George Eliot the agricultural people. In this way we get a thorough knowledge of one nation and quite an extended knowledge of many others, also a drilling in the best of literature. Is it not much more practicable and sensible than to read perhaps "Trilby," followed by "Ten Years' Digging in Egypt," "John Halifax, Gentleman," "My Opinions and Betsy Bobbitt's," "Mary Queen of Scots," "The Heavenly Twins," "Lorna Doone," "All he knew," finishing a month's reading with "Old Bethlehem"? These are all good books in a way, but bear about as much relation to each other as the almanac bears to the history of China, Japan, or Arnold's "Light of Asia."

The reason for this hap-hazard way of doing is that so few read for lasting good and to make the most of time and opportunity. Some read to kill time; others to prepare for a nap; some to keep cool; others dawdle over books with minds half asleep; some read from habit; others to be thought literary. We must admit, however, that it is better to read good books in this way than to be idle or misemployed. A great number of students are working in the homes. The evening hours, the waiting times and spare moments are made available for any line of study chosen, and good work is being done.

Putting aside students and systems, the question, "What shall we read?" confronts us. What shall not be read may be a much easier query to answer, because what to read simply as desultory reading depends much on the intellectual status of the reader. The obvious truth is, some do and always will read what they like, irrespective of any other object or guidance. But literature belongs to that kind of knowledge which is power; therefore, to read nothing but newspapers and novels is not only a waste of time, but tends to weaken the powers of attention and concentration and relax the mental fibre. Howells says, "The women are in fact the miscellaneous readers in our country. They make or leave unmade most literary reputations." Another noted author says that "Genius is subject to the same laws which regulate the production of cotton and molasses,— the supply adjusts itself to the demand." There being many women, there is an enormous demand. To meet this, a host of writers have entered the field who make a good livelihood, yet lack moral stamina. They fashion too much after French models. The workmanship of the French is superior to ours, but the subjects have demoralizing tendencies in too many cases. In this business, as in every other, skilled workmen are few.

That Americans are a novel-loving people, is a fact. Stories are to amuse and for mental recreation, yet they have a potent formative force, especially upon the young. If the yellow-covered dime novel will cause boys to run away to sea and elsewhere, and girls to elope, then the highly moral, elevating story must help in the making of noble men and women, by the same law. Many of the vices of to-day are the result of evil thoughts suggested by bad books and papers. It has been stated that in 1840 we had in these United States one criminal in about three thousand people; after fifty years of progress, in 1890, we had one in about seven hundred people. The cause attributed for this degeneration in morals was a political one. Low grades from foreign nations, as American citizens, have made demands even in the line of reading matter, and have generally got what they asked for. Editors of daily papers tell us that crime must be set out in the most intense, detailed and emphatic manner, to suit the abnormal tastes of the many whose appetites have become vitiated by long gorging on indecencies. Too much literature is made for money, to while away time, without even an *ethical trend.*

As we are in the mass a novel-reading people, and likely to remain so, it may be well to consider the different classes of prose fiction. "Evelina," by Frances Burney, afterward Madam D'Arblay, was the first English novel that survived. Previous to that the very name of novel was a "horror" to all decent people. They called the circulating library an evergreen tree of diabolical knowledge. Miss Burney's appearance and work were an important epoch in English literary history. Her books were forceful, yet moral and clean. It opened the way for women in letters, and made that way honorable.

We have the romancer, the idealist and the realist. The romance sprang up in the middle ages in the form of "Arthur and the Round Table," the Holy Grail and Parzival. As a school it was opposed to the classical style. To be exact, there was a difference between a romancer and a romanticist. The one has reference to the spirit, and the other the style, of writing. The romance movement culminated in Scott. He was the typical romancer. His novels are the highest type of prose fiction. Not only do we find the plot and adventure, but keen observation of life and knowledge of men. "Ivanhoe" is pronounced by many the best novel ever written. In this romantic school we find the poets Gray, Collins, Wordsworth and Cowper. Milton still held to the classical style, being the most scholarly of the English poets. His books are of the highest moral character.

The idealist delights in an imaginary standard of excellence, such as exists only in the imagination. The ideal is the gathering of all good into one character, excluding every defect. Both the idealist and romancer indulge in all kinds of picturesque fancies, not quite to the degree of being sensational, although some come near it.

The realist deals with commonplace affairs that he actually sees. He imagines nothing, and deals with the practical. William Dean Howells is a typical realist. His lack of noble ideals has been adversely noted by foreign critics. Lady Verney, in a criticism in a foreign magazine, says, "Is it fair to judge of American women by the pictures drawn in American story books of to-day? The first and most striking trait in these books is the extraordinary respect for class distinction, position and money. Next comes the value set upon dress. The importance of the gown question as portrayed in American books can hardly be imagined by the European mind." Consequently the lady concludes from these specimens that the American young lady must be a supremely uninteresting human being. This conclusion is not pleasant for us to contemplate; but our American mind is relieved, however, when we remember that Bishop Brooks said that "It is not what we have or what we know that decides for us our right to the title of true womanhood, but what we are; and what we are is the result of multiplying our characters by our circumstances." If Howells has been faithful in obtaining a true product of such a multiplication, then we must accept his version; for, if he sees a beggar, he is only a beggar, and not a prince in disguise.

The realistic movement was thought to have done much for Germany at the time when she seemed incapable of rising above her condition. She had waded through centuries of blood, fought for religion and recognition among the nations, sacrificed the lives of thousands of her people for the unification of the whole. Although successful in politics, the condition of the individual had not improved. All the learned men began to analyze life, and all came to the same conclusion. They must strike at the root of the matter. They tried to find the root, but could not. They became depressed, and so expressed themselves in their literature. At the time when she stood highest, she turned to pessimism, or the assumption that the worst will happen, and we cannot help it. Yet men kept thinking. All at once they turned to realism. Idealism with Goethe at its head was discarded. They said that the roots of the tree of society rested in the soil of a poisonous lie. They began to encourage the masses by showing them that there was a chance for every one on higher ground; that nobody in real life ever was or could be like the ideals set before them; that in real life no one acts or speaks like those in romance, neither when they are happy nor angry, not even when they are in love, unless they are cranks. Those new novels had for their subjects the stirring events of the times, and were peopled with real peasants. The work struck a powerful chord in the heart of the German people. The tree began to feel the influence of the soil called truth, and grew and throve.

The eternal law of nature is the spirit of the realist. Robert Southey said there was another class of writers, called the "Satanic school," of which Lord Byron was the leader. There was reason for this, for Lord Byron had created in the minds of many an association of intellectual power with moral depravity. The ethics drawn from his poetry, says another noted writer, seemed to centre in two great commandments: "Hate your neighbor; be sure to love your neighbor's wife."

If we wish perfection of form or something for study in style we must go to the classics for highest teachings, bearing in mind their limitations, that they were pagans seeking for light. If a Greek wished instruction, he walked to the market place. All their instruction was by dialogue or conversation. Socrates conversed with Plato and many others. He caused much to be written, but did not write a word himself that has survived. Homer's "Iliad" is the leading poem of the world in regard to art. Herodotus, 484 B.C., was the father of history, as Homer was the father of poetry; Socrates, the foremost philosopher; Plato, the foremost philosophical writer; Sappho, the foremost woman of genius, and whom Plato called the tenth muse. Æschylus represents tragic poetry and Demosthenes oratory, and with Demosthenes perished the last of the free voices of Athens. Greece was the first civilized nation of Europe, and many of the ideas and institutions of the world had their source with the Greeks.

The Greek literary spirit did not die with Demosthenes, but took a flight to Rome and into all the various literatures that have flourished in Europe since the Christian era. In Rome it manifested itself in Cicero, Sallust, Virgil, Horace and Juvenal. Those Romans gave a language and also a law and spirit to early French literature which was entirely unlike that of the present period. Out of the confusion Dante brought the Italian tongue. He was its creator. No man except Shakespeare has looked on mankind with a more penetrating eye. It is the opinion of many critics that his "Divine Comedy" is the only poem of more modern times which can compare with Milton's "Paradise Lost." What the men were in their inner lives marked their works with a different spirit. Milton was exalted. Although he had blindness, sickness, poverty, domestic trouble, public neglect and abuse, yet he rose superior to all, and dwelt in a majestic peace. Dante was melancholy, and it came from within as well as from without. He was uniformly sorrowful, and so marked his work. So we mark our efforts in life with what we are.

French literature, taken as a whole, may not be the wisest or purest, but is full of life and brightness. French classicism had its culmination in Louis XIV., in the 17th century. The Hotel de Rambouillet and the French Academy were the two organized forces that did the work. The Academy was established by the great Cardinal Richelieu in the time of Louis XIII.; and the salons by the wife of Marquis de Rambouillet, for the purpose of trying what feminine wit and virtue could do towards regenerating the manners and morals of France. These were wonderful gatherings. Here came Balzac and Voiture, Corneille and Descartes, Bossuet and Bourdaloue, and here Madame de Sévigné brought her beauty, wit and unblemished reputation. This was the grand intellectual age of France, Louis XIV. himself being the centre of all literary movements. Then came the writings of the infidels, Voltaire, Diderot and Rousseau, in the 17th and 18th centuries. They prepared the way for the French revolution. During this time their literature was nearly extinguished. The salon flourished until the middle of the present century, expiring with the beautiful Madame Récamier. The two bright stars of the last part of the 18th and first part of the 19th centuries were Chateaubriand and that great woman whom Napoleon feared, Madame de Staël. Victor Hugo's great personality combined with Shakespeare's influence at last broke the power of the classicists and gave the lead to the romancer. Victor Hugo became the mouthpiece of an outraged nation. Gambetta was one who caught the spirit of his writings. Hugo was exiled to the Isle of Guernsey, and for eighteen years he stirred France, whether they would or not. All his romanticist friends were faithful to him; even those who accepted the Emperor, like Gautier and Sainte-Beuve, stood by him. In the closing days of the empire "Hermani" was put upon the stage and was warmly received by the people. So during the entire reign of Napoleon III. Hugo lived in the midst by his mighty pen.

We owe much to the Germans for one thing and another. But we must be wise and discriminating. They are a broad-thinking people. Broad thinking without depth is apt to be free thinking. Their literature was born with Martin

Luther's great translation of the Bible into German. Lessing's bold criticism upon Voltaire was an influence felt by the whole western world. Voltaire was the mighty power of his time, and swayed all France with his skepticism. Viewed from our 19th century stand-point, there were many extenuating circumstances in his case. Christianity was presented to the world at that time by Catholicism only. The Roman Catholic Church at the time was so corrupt that the priests acknowledged they could scarcely perform their duties with a sober face. Voltaire's sharp eye saw through the meshes where other eyes did not penetrate. The Germans Richter and Schiller are morally inspiring. Goethe with his "Faust" we leave to the taste of the reader.

For a book in which to find a concentrated account of modern Europe, read "Rome and the Making of Modern Europe." Some of our best history is poetry. Much of English history is learned from Shakespeare, of the early German from the "Niebelungen lied," their national epic, and of the Spanish from the "Cid."

American literature of any merit is the product of the last three-quarters of a century. In the early times men were acting, and not writing. There was scarcely anything, previous to Washington Irving's "Knickerbocker's History of New York," worthy to be called literature. In 1823 Cooper's "Pioneer and Leather Stocking Tales" were published, portraying the restless energy and love of adventure which were a feature of American life at that time.

Then came the Unitarian revolt from Puritan Orthodoxy, led by Channing. This has had an influence upon every soul born within the last half of the century. It was an intellectual movement, and prepared the way for eminent writers of the next generations. This movement took different features in other parts of the world, but in New England it took its point of departure in the churches, as did every change. This movement culminated in the only school of writers of which America can boast, — the Transcendentalists. Transcendentalism is a high form of idealism. It resulted in the formation of the Brook Farm community at Roxbury, a society governed by socialistic principles. It proved a failure. Geo. Ripley, a Unitarian clergyman, was its leading man. Ralph Waldo Emerson, descendant of eight generations of clergymen, was the foremost spirit among these Transcendentalists. Theodore Parker was their pulpit orator. This was still another departure from conservative Unitarianism.

The Channing Unitarians, while denying that Christ was God, held him to be divine. While rejecting the vicarious sacrifice, they accepted him as a mediator, and believed in miracles. The Transcendentalists called Christ simply a good and great man, divine only in the sense that God possessed him more fully than any other known. They placed him with Buddha, Socrates and Confucius, and the Bible with all other ethnical writings. Among these writers were Thoreau, Alcott and Margaret Fuller. They published two papers, the "Dial" and the "Harbinger." Upon their pages were found the names of such men as Horace Greeley, Geo. W. Curtis and T. W. Higginson. Emerson sweetened and brightened all the byways and places in rural life by his highly idealist views, and his books are dear to all nature lovers. He was called the "glorified farmer," because he so much loved secluded places, where he could commune alone with nature. He was exalted in thought and aspiration. He said, "Let every man live as upon a mountain, so the world may see how God intended a true man to live." He tells us to "hitch our wagon to a star," etc.

Later these writers made Concord, Mass., their home. That village has done more for American letters than some cities. The men who made it famous are asleep in Sleepy Hollow, yet their memory and what they have done is still able to draw many people to the spot. There was the home of Hawthorne. In the "Old Manse" he carried on his literary work. We call him the greatest American romancer. With the conscience for his theme, and the subtle ways in which sin works out its own retribution, he tells us of the sombre lives of the early settlers. His "Scarlet Letter" is pronounced the best novel written on this side of the water.

Emerson, Holmes, Phillips, Motley, Prescott, Longfellow, Lowell, Felton and Edward Everett Hale were a brilliant group of men, living at the same time in the vicinity of Boston. Longfellow's mission was to refine our taste, —he was the pioneer of culture. In England he was called the poet of the middle classes. Those classes, however, include the majority of intelligent readers. Puritanism was opposed to beauty, and looked upon sentiment as idle and weak. Longfellow so beguiled their reason through their finer senses that they were satisfied that loveliness and righteousness might go hand in hand. He began as a translator, and so remained all his life, and infused the fine essence of European poetry into his own. The influence for good exerted by his tenderness and truth is boundless. He gave a long, clean life to his work. He tells how beautiful it is to mix with and read the world, yet keep a pure heart, avoiding recklessness and vice. He admonishes us to go forth to meet the future without fear and with a stout heart. His successors do not find him satisfactory in style, but his wisdom and faithfulness to the best things in life have rested in the hearts of many friends.

Among these literary men of that day Holmes ranked first in versatility; Lowell, as critic; Bancroft, Motley and Prescott are our own historians; Whittier sang his songs straight out from the heart, — his poems on slavery were like the blast of the last trump. Great movements have always taken character from the literature of the day. Harriet Beecher Stowe's "Uncle Tom's Cabin" did more than any other literary agency to rouse the people to the sense of a neglected duty. She did more than Garrison, Whittier, Lowell, Sumner or Phillips.

The war of the Rebellion brought changes in the intellectual forces of our country. Authorship was no new thing. Thought had passed from nation to nation, from Greece to Italy, from Italy to France, from France to England, from England to France and Germany, etc. All the old writers — Chaucer, Milton and Shakespeare — borrowed from Italy, Goethe and Voltaire from England, and all writers from Greece and Rome. America has always been proud. The war gave us new pride, and we disliked to borrow from other nations. While there were chances innumerable for the romancer, there started up a mania for realism, for bare surface facts. Bayard Taylor gave us "Hannah Thurston," a distinctly American book. Holmes, Higginson, Beecher and some others still adhered to their old way.

In 1871, Bret Harte, after living many years among the mines and mountains of California, gave us his California stories; Rebecca Harding Davis brought choice thoughts from Pennsylvania; Edward Eggleston talked to us of the early days of Indiana; Trowbridge showed us New York life from the village point of view; Constance Fennimore Woolson portrayed the life as manifested in the northern lake region; George W. Cable contributed histories of French Creole life in Louisiana; Sara Orne Jewett dealt with ideal scenery in isolated places; Mary Hallock Foote dashed across our vision with the olive leaf of peace, as she touched the sweetness of Quaker life; Miss Murfree told of the mountain districts of Georgia, Carolina and Tennessee; Joel Chandler Harris translated the folklore of the negro plantations of the South; Mrs. Whitney still continued to tell good stories of girl life; Dr. Holland took a new impulse, and wrote "Arthur Bonnicastle" and "Seven Oaks," the last being rich in material from the social and civil impurities of the day. Julian Hawthorne, Lew Wallace and Edward Everett Hale came before the public as new men, each taking his own prescribed way.

Yet we say we have no decidedly national literature. It takes many years to evolve such. Herbert Spencer says, "Because of its size and the heterogeneity of its components, the American nation will be a long time in evolving its ultimate form, but its ultimate form will be high." Emerson and Longfellow are the real founders of American literature. They will not satisfy those who seek the sensuous in life, but they did the most to instil the true idea of poetry into the minds of the masses. Wordsworth predicted, more than half a century ago, that some day there would come before the people a person who would be a union of the poet and philosopher. Emerson most nearly fulfilled this prediction. We realize that the greatest poet has not yet come to us. These of whom we have spoken are but stepping-stones to a grander one, who shall study mankind and life in all its phases, from war and the warrior to the meekest soul and its environment. He will be the true apostle, with a power to grasp all our American characteristics, at the same time setting before us the highest standard of living, as given us by One who preceded. In the mean time, we accept all the good, but shall persist in saying that in neither this generation nor the next will any be able to dethrone our Longfellow, Bryant and Whittier, nor to elevate Tolstoi, Brandes and the Frenchman Zola to occupy those places so long held by Dickens, Thackeray, Hawthorne, Irving and others.

Realism cannot be carried to that extent in a country settled so recently by a class of people called Puritans, who derived their peculiar characteristics from the daily contemplation of superior beings and eternal interests. If they were unread in literature, they were deeply read in the oracles of God. That spirit has not become entirely stagnant. We still aspire to get beyond our present condition, hoping for a higher and better. How rarely do our words reveal the aspirations of our real inner self. Therefore there is need of looking beneath the surface of things.

Books of the right sort are on every hand. We may travel not only around the world, to all parts of it, with scores of people, but to the sun and even the stars. Geology takes us back to the formation of the earth, and all the way down through the ages tells us wonderful stories from out the truthful past. In the past really great men were produced by our social conditions and form of government. Their principle and conscience worked for the good of the people in a way that resulted in power and influence. The biographies of such men should furnish to every American youth examples of industry, temperance, principle and steadfast courage. To read means something more than repeating lines or words. Everything a person does in this direction should serve in future usefulness. Even the child may so lay a foundation for knowledge. The history of the earth and its geography; plain lessons in natural science, portraying the wonders in nature; the facts so interesting to all, both old and young, — any teacher or person who can implant a love of such books in the children is a true missionary.

Literature as taught in our public schools strengthens the intellect, but leaves the best part, the moral part, uneducated. It is a hard fact for optimistic people to recognize that while we are growing wiser fast we are growing better slowly. The *nature* studies will bring about a change in this direction by taking the pupil through God's works up to him. If we need a training in the classics for any special purpose, it is for teaching us how to use our own mother tongue uniformly well. The American person is a free and independent person, and is just as free and independent with our English. Every trade and profession has its own particular slang. Students of all ages, from the primary school to the college, abound in it. Having so many books has made us careless. Those old Greeks and Romans had no knowledge of the slang of the 19th century. Every sentence of theirs must be rendered in good English at every point. To do this there must be care and attention to what we are doing with words.

Education is only a means to an end. Therefore we need those books which will most surely help to broaden, deepen, invigorate, making us more useful in the world. These silent friends of whom we have been speaking cannot do their grandest and best work for us until our inner life has been stirred or inspired. That word inspiration has a deeper and more intricate meaning than we casually think. In the original it means "I blow upon or into." From one Book we learn the true source of all high and holy inspiration. Education is helpful, and we must have it. Morality is right, useful we ought to be, and all good books are auxiliary to the Book of books; yet, if we have missed in any way this "blowing in upon" our lives from the true source, it has been our own great mistake. We also have learned that we should receive a marvellous light reflected from its Author, and that this light, if we receive it, will brighten the gloomy places in life and quiet the unrest of the human heart. Go back through all the cycles of life, through every epoch, and the same light is there, everlasting, abiding forever. If the proof of the eternity of a thing is the trial of ages, we must accept this verity now and forever. It is life we are dealing with, and all our training, be it ethical or religious, is only helpful and of the right sort when it helps us to have a power, first over ourselves, and through ourselves over others.

As country people, let us keep in mind that some of the most enduring work the world has known has been done in the quiet of rural life or in retirement. It was in the silence of a prison that Bunyan did his best work; it was in exile and alone that Dante and others did theirs. So in the silence of isolated places we may do our best work. It may not be the writing or making of books, but what Providence assigns to us will be *our* best work, and we may do that thoroughly and well, at the same time reaching a depth of things enabling us, with God's help, to rise above, or equal to, all conditions and circumstances.

THIRD DAY.

The meeting was called to order at 9.50 A.M., by Vice-Pres. FRANCIS H. APPLETON of Peabody.

After several selections by the Oberon Ladies' Quartette, the chairman said: One-third of our cows pay their way, one-third are kept at a loss and one-third bring in the profits. Feeding must of necessity be one means of increasing the profit from our poorer cows by increasing the total bulk of milk, and thus increasing the total amount of fats received, which yield us the profits from our cows. Another thing, which to my mind we in Massachusetts give too little thought to, is the improving the quality of our cows by better breeding, and thus increasing the total amount of fats they yield. We are very largely dependent on those outside our borders for our milch cows, and we should do everything we can to promote the interests of the breeder, and encourage our farmers to breed live stock for our milk supply that shall be better able to yield us fat in the milk, and also increase the quantity of milk, so that we may have a greater bulk of fat. It gives me great pleasure at this time to present to you Dr. J. B. LINDSEY of the Hatch Experiment Station at Amherst.

Dr. LINDSEY. I wish there were a few more farmers from our local farms here, for I fear that possibly what I have to say to you as members of the Board of Agriculture you are already familiar with. Nevertheless, what I have written I have written, and so you will bear with me while I discuss the subject assigned to me.

HOW THE AGRICULTURAL COLLEGE AND EXPERIMENT STATION BENEFIT THE FARMER.

BY DR. J. B. LINDSEY, AMHERST, MASS.

Gentlemen of the State Board of Agriculture: In addressing you this morning upon the above subject, I am convinced that we shall best attain the end in view if we attempt to consider, first, the equipment and work of the agricultural college of to-day; second, some of the most important work accomplished by the two experiment stations in Massachusetts during their existence; and third, the plan of reorganization and the scope of work to be undertaken by the consolidated station.

I.—The Agricultural College.

Any one who visits the college for the first time will be very much surprised at the extent and beautiful appearance of the entire plant. The area of land belonging to the institution approaches in extent four hundred acres, situated about one mile north of the town of Amherst, the location being one of the most charming and healthful in the whole world. The principal college buildings are eight in number. There are two dormitories, capable of holding one hundred and fifty students. Both of these buildings are lighted by electricity from the college plant; one of them has steam heat, and the other is warmed by stoves supplied by the college. The young men furnish their own rooms, which are inspected every Saturday morning by the military officer in charge.

The large wooden building to the north of the dormitories, known as the old chapel, is occupied on the lower floor by the chemical laboratories, and the upper floor is devoted to the chemical and mathematical lecture rooms. The elegant new stone chapel occupies a well-chosen position, and is a decided ornament to the college grounds. The lower story contains the college library, and the upper one is used as a general assembly room for the entire student body. All religious exercises are held in this room. The library of the college is deserving of more than passing notice. It contains at the present time nearly seventeen thousand volumes, and is one of the finest, if not the very finest, of its kind in the United States. The extremely arduous work of selecting, arranging and cataloguing this collection of books has been brought about by the indefatigable labor of our present energetic president. In addition to his many other duties, he has toiled long and hard to accomplish this end. I am convinced that the college owes him a great debt of gratitude, which it will never be able to fully repay.

Just to the south of the chapel is situated the commodious drill hall, used especially during the winter months for various military and gymnastic exercises. It contains a large recitation room, and recently a gun shed has been added, which furnishes also room for winter target practice. This building is equipped with electric lights, and is open both during the day and evening, serving as a place for any amusement in which the young men may desire to engage.

The large new barn with dairy school attached is the latest and most valuable acquisition to the college. It is a model of its kind, and is worthy of inspection by every progressive farmer in the Commonwealth. A full description of the barn, with photographs, will be found in the report of the college for 1894. The college farm has been greatly improved during the last ten years, and is also well worth a close examination, especially during the summer months. As much of the labor as possible is accomplished with the aid of the most improved implements, and any young man has abundant opportunity to become practically familiar with all kinds of farm machinery, and with improved methods of farm practice.

Situated on the hill on the opposite side of the farm is the building known as the botanic museum, together with the other buildings of the botanical and horticultural department. This building contains two large recitation rooms, fitted up with a most valuable herbarium, collections of models and charts. It also has a finely equipped botanic laboratory, with accommodations for twenty-five students at one time. The large greenhouses near by are filled with a collection of plants from both the tropical and temperate zones. Opportunity is here offered for students to become practically familiar with all kinds of commercial greenhouse work. The grounds about this department are very tastefully laid out with trees, shrubs and flowering plants. The vineyard contains all the desirable varieties of grapes, the orchards are extensive, and a large tract of land is devoted to market gardening. Young men so inclined, thanks to the generosity of the State, have opportunity to work for pay in each of these several lines, securing both a scientific and practical knowledge of the business.

The entomological department, not far distant, has recently been housed in a new building planned by Professor Fernald, and is fully equipped with all the modern improvements and necessary apparatus for a thorough study of economic entomology.

Course of Study.

The course of study, an outline of which is given in the subjoined table, is worthy of consideration. The regular course occupies four years, and the degree of bachelor of science is awarded to those completing it. In the senior year all of the studies except English and military are elective, thus enabling the older students to select for their maturer consideration those studies which in their judgment will prove of greatest benefit to them in the future. In addition to the four-years course, a course of two years has recently been provided for those who feel that they cannot afford the time and money necessary to complete the former. The college catalogue gives full particulars.

FOUR-YEARS COURSE OF STUDY.

Freshman Year.

	Agriculture.	Botany and Horticulture.	Chemistry.	Natural History.	Mathematics.	Latin and English.	French and Social Science.	Drawing and Military.
Fall, . .	- - -	Botany, structural, — 5.	- - -	- - -	Advanced algebra, — 5. Book-keeping,—2.	English, — 2.	French, — 4.	Study of tactics, — 1.
Winter, .	History of agriculture, soils and soil formation, — 4.	- - -	- - -	- - -	Advanced algebra and geometry (plane), — 4.	English, — 2.	French, — 4.	Mechanical drawing, — 6.
Summer, .	Soils: — characteristics, improvement of, drainage, etc., — 4.	Botany, analytical, — 4.	Lectures in elementary chemistry, — 3.	- - -	Geometry (solid), — 3.	English, — 2.	French, — 3.	- -

Sophomore Year.

	Agriculture.	Botany and Horticulture.	Chemistry.	Natural History.	Mathematics.	Latin and English.	French and Social Science.	Drawing and Military.
Fall, . .	Irrigation, disposition of sewage, manures and fertilizers, — 4.	Botany, economic, and laboratory work, — 4.	Lectures in elementary chemistry, — 4.	- - -	Trigonometry,—3.	English, — 2.	- -	- -
Winter, .	- - -	Laboratory work, — 4.	Lectures and practice, — 4.	Anatomy and physiology, — 4.	Surveying, — 3.	English, — 2.	- -	Mechanical drawing, — 4.
Summer, .	Relations of the atmosphere to plant life, mowings, pastures, grasses, ensilage,—5.	Horticulture, — 5.	Dry and humid qualitative analysis, — 3.	- - -	Surveying, — 4.	English, — 2.	- -	- -

JUNIOR YEAR.

	Agriculture.	Botany and Horticulture.	Chemistry.	Zoölogy.	Mathematics.	Latin and English.	French and Social Science.	Drawing and Military.
Fall, . .	Field crops, seed raising, production and improvement of varieties, machines and implements, — 4.	Market gardening, — 3.	Qualitative analysis, — 5.	Zoölogy, laboratory work, — 8.	Physics, — 2.	Rhetoric and composition, — 4.	- -	- -
Winter, .	Breeds and breeding of live stock, poultry farming, — 2.	- - -	Lectures and practice in organic chemistry, — 6.	Zoölogy, — 3.	Physics, — 3.	- -	English literature, — 4.	Descriptive geometry, — 4.
Summer, .	- - -	Landscape gardening, — 5.	The same continued, — 5.	Entomology, — 6.	Physics, — 4.	English, — 2.	- -	- -

SENIOR YEAR (ELECTIVE).*

Fall, . .	Dairy farming, — 5.	Botany, cryptogamic, — 8.	Chemical physics and quantitative analysis, — 8.	Entomology, — 8. Veterinary science, — 5.	Engineering, — 5. Analytical geometry, — 5.	English, — 2. Advanced English, — 5. Latin, — 5.	Political economy, — 5. German, — 5.	Military science, — 1.
Winter, .	Cattle feeding, — 5.	Botany, cryptogamic, — 8.	Advanced work with lectures, — 8.	Entomology, — 8. Veterinary science, — 5.	Engineering, — 5. Differential calculus, — 5.	English, — 2. Advanced English, — 5. Latin, — 5.	Political economy, — 5. German, — 5.	Military science, — 1. Law lectures, — 1.
Summer, .	Experimental work in agriculture, — 5.	Botany, physiological, — 8.	The same continued, — 8.	Entomology, — 8. Veterinary science, — 5.	Engineering, — 5. Integral calculus, — 5.	English, — 2. Advanced English, — 5. Latin, — 5.	Constitutional history, — 5. German, — 5.	Military science, — 1.

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* English and military science are required; of the other studies three at least must be chosen.

One notices first the study of agriculture proper, beginning with a brief consideration of the history of the art in earlier times, and continuing down to the present; then follow the formation, character and classification of soils, with methods of improving them. A series of lectures is devoted to mowings and pastures, the value and peculiar character of different grasses, how to grow and preserve ensilage, and its value in farm economy. A course of lectures is devoted to farm manures and fertilizers; the nutrition of farm crops, what farm manures are and how best to turn them to account, the composition of crude fertilizing material, how commercial fertilizers are made up, and the most economical way to purchase nitrogen, phosphoric acid and potash, are some of the special topics considered. Field crops and the best methods of growing them are dwelt upon, as well as the most suitable implements and machinery to be used in their cultivation. Distinct courses of lectures are devoted to breeds and the breeding of farm animals, cattle feeding and dairying. The dairy school, which, owing to financial conditions, has not been started, will, it is hoped, be shortly in full running order.

Considerable time is devoted to the study of botany, *i. e.*, to the variety, structure and growth of all forms of plant life. By structural botany is meant a study of various groups of plants, with reference to their different forms and to the shape and structure of their various organs. A knowledge of analytical botany enables one to identify and classify plants, shrubs and trees. Physiological botany teaches the functions of the different plant organs, and shows how the plant elaborates its food in order to produce what is termed plant growth. Special study is given to plants of economic value under the head of economic botany. In cryptogamic botany one devotes himself to observations on the lower forms of plant life, special attention being given to the fungi producing the various plant diseases known as rusts, blights and mildews, and to the different bacteria which produce such changes in many farm products, and play so prominent a part in plant growth.

In horticulture instruction is given partly by lectures and partly by practical demonstrations out of doors. The extensive orchards and gardens already alluded to, enable the student to learn the best varieties of all kinds of fruit, including methods of planting, pruning, training, cultivation, as well as gathering, packing and shipping. In the nursery practical instruction is given in propagation by cuttings, layers, budding, grafting, etc. Ornamental trees, shrubs and flowering plants are grouped about the grounds in such a way as to afford as much instruction as possible in the art of landscape gardening.

There is no science more necessary to any one who would become a successful farmer, gardener or fruit grower than that of chemistry; and the college is to be congratulated that this department, both as regards instructors and apparatus, is so well equipped. The student first receives lectures on the principles of chemistry. He is then conducted a step farther, taking up the study of inorganic substances. Both by lectures and laboratory work he learns about the various gases; concerning the alkalies, potash, soda and ammonia; the alkaline earths, lime and magnesia; the heavy metals, iron, manganese, etc.; and all the inorganic or mineral acids. Next comes the fascinating study of organic chemistry, which deals with all substances making up the organic, as distinct from the inorganic or mineral world. A familiarity with organic chemistry is very necessary to the educated agriculturist, and the recent enlargement of this part of the chemical course is in touch with the general progress which the college has been making in its other departments. If one desires a clear understanding of the chemistry of milk and its products, of animal nutrition, and of the manifold substances produced during the process and as a result of plant growth, he should devote a portion of his time to listening to the lectures in organic and physiological chemistry and to the laboratory work connected therewith. Students who have completed the prescribed course in chemistry can devote their time to special subjects, such as dairy, fertilizer or animal chemistry.

A most excellent course is given in economic entomology, both by lectures and laboratory work. The new laboratory, already alluded to, is fitted with every modern appliance for such work. In it are embodied the best ideas both from at home and abroad. The student becomes acquainted with all the common injurious insects preying on crops and orchards, and with the best methods of combating them. By practical work he also acquires a knowledge of the anatomy and physiology of the insect, and is taught to carefully observe its habits of life. Professor Fernald's aim is to offer the best course in economic entomology to be found anywhere in the country. In the study of zoölogy the student is given as complete an idea as possible of the entire animal kingdom, from the lowest to the highest forms of life. Charts, collections and laboratory work all aid in studying this science.

Instruction in veterinary science is given by lectures, with the aid of charts, models and practical demonstrations. It is not intended to turn out veterinary surgeons, but to familiarize the student with the anatomy and physiology of farm animals, and give him an understanding of their common diseases and the best methods of treatment.

Agriculture and the kindred sciences form, as you see, a very prominent part of the course of instruction, but mathematics, as well as mechanics, physics and practical surveying, are by no means put in the background. Neither is instruction neglected in history, the languages and in political economy, for these are requisite to a liberal education. A liberally educated man, said the late Dr. Holmes, "should know everything about something, and something about everything."

The military department of the college should not be overlooked. Every student not physically disabled is obliged to drill three hours per week, and receives in addition instruction in military law, fortifications, science of war, army administration, composition of armies, the military used as an aid to civil authority, etc. Every one who has had opportunity to observe the effect of this department of college instruction on the general health and deportment of the young men is loud in its praise.

I must not forget to mention the religious side of the student's life. Every Sunday morning he has opportunity to attend a regular Bible class, and is obliged to attend the regular morning preaching service held at the college, conducted by the college pastor, unless especially excused to attend some church in town. The Young Men's Christian Association connected with the college holds two prayer and praise services weekly.

EXPENSES.

Tuition in advance: —		
Fall term,	$30 00	
Winter term,	25 00	
Summer term,	25 00	
Total tuition,	$80 00	$80 00
Room rent in advance, $8 to $16 per term,	24 00	48 00
Board, $2.50 to $5 per week,	95 00	190 00
Fuel, $5 to $15,	5 00	15 00
Washing, 30 to 60 cents per week,	11 40	22 80
Military suit,	15 75	15 75
Expenses per year,	$231 15	$371 55

Board in clubs has been about $2.45 per week; in private families, $4 to $5. The military suit must be obtained immediately upon entrance at college, and used in the drill exercises prescribed. The following fees will be charged for the maintenance of the several laboratories: chemical, $10 per term used; zoölogical, $4 per term used; botanical, $1 per term used by sophomore class, $2 per term used by senior class; entomological, $2 per term used. Some expense will also be incurred for lights and text-books. Students whose homes are within the State of Massachusetts can in most cases obtain a scholarship by applying to the Senator of the district in which they live. Any young man of economic habits who secures a scholarship will find $250 sufficient to cover all expense; a portion of this he can earn, if he desires to do so.

For what the Training prepares the Student.

When an industrious young man is graduated, we are sure, if during his course he has developed a liking for any line of agriculture, that he has a good understanding of both its principles and practice. We are equally sure that every studious graduate has secured a good, liberal education, which is needed by every young man of enterprise, whatever his future occupation. Such training serves also as an excellent foundation for those desirous of taking up some special line of work, be it teaching, investigating, medicine, or of a mechanical nature. According to Professor Brooks, from statistics gathered in 1892, of the three hundred and thirteen men who had then been graduated, rather more than one-half were engaged in agriculture or closely allied pursuits. One-sixth of all graduates were employed in agricultural colleges and experiment stations. There were two college presidents, several professors of agriculture and two directors of experiment stations. Most of those not engaged in agriculture were in various lines of business. We find, however, eighteen doctors of medicine, nine lawyers and four clergymen.

We do not suppose for a moment, however, that all of our graduates will be equally good farmers, or will be equally well educated. As the late President Chadbourne once said, "It depends upon the material you send us, gentlemen." All of the chemistry known to man is not able to turn an inferior metal into gold; but if the rough mineral contains the gold, the dross can be removed and the true metal refined and beautified.

The college, then, is a direct benefit to the farmer in educating his son at a minimum cost; and the young man, if he is made of the right stuff, is in turn a benefit to his father and his neighbors, in the new intelligence and understanding which he puts into the various operations of the farm. Even if the graduate does not engage in agriculture directly, he has a practical understanding of what farming is, he has classmates who are farmers, and he will always be ready, both with voice and vote, in aiding them to secure whatever is right and just.

Gentlemen, the doors of this, the farmers', or better, perhaps, the people's college, are wide open. We ask you to visit the institution and judge for yourselves of its merits;

and, what is better still, send your sons, in order that they may have an opportunity to secure what is better for them than a legacy of silver or gold, — a liberal education.

II. — The Experiment Stations.

I think we shall best be able to form somewhat of an idea of how the experiment stations of our State have been a benefit to the farmer, if we attempt to consider some of the most important work in which they have been engaged. Until recently there have been two stations in the town of Amherst, — the State station, situated on the college grounds but having no direct connection with it, and the Hatch station, established by the United States and constituting a part of the college proper. Time will not permit us to consider the work of the two stations separately, and for our purpose this is not necessary. Their work, taken collectively, can be divided into three parts: (*a*) control work, (*b*) information, (*c*) investigation.

Control Work.

The work of exercising an official control over the sale of commercial fertilizers was at first in charge of an inspector, but a few years later the law was so changed as to vest the power in the director of the State station. Deputies have been sent out each year, who have canvassed the State, and made an effort to collect several samples of each distinct brand of fertilizer placed upon the market. These samples have been analyzed, and the results published, as you are aware, in various bulletins and reports. That this work has been of immense benefit in protecting the farmer against fraud goes without saying; it has been a safeguard to the honest manufacturer, as well. The law, briefly stated, compels the manufacturer to guarantee what he sells and to sell what he guarantees. With very few exceptions the law has been strictly obeyed. In addition to this official inspection, the chemical department has received from farmers of the State a great variety of all kinds of material for analysis. This material consisted of crude and mixed fertilizers, cattle feeds, milk, cream and water. The analyses have been made free of expense, and reported to the farmers with the necessary comments.

Information.

Secondly, the various departments of the two stations have been constantly in receipt of a great many letters from farmers, asking for information on all topics connected with agriculture. It has been the object of the station workers to answer as fully and as promptly as possible; but it must not be forgotten that this involves no inconsiderable amount of work, for the desired information is not always on the tongue's end, considerable research being often necessary to secure it.

Investigation.

In addition to the control work and the furnishing of information, the stations have endeavored to devote a considerable portion of their time to investigating some of the manifold problems concerning which an increased knowledge is so much needed. Many subjects to be investigated require a great amount of scientific work, which can be only fully understood and appreciated by those engaged in it. I am convinced, however, that it is just this kind of work which is eventually going to be of the greatest benefit to the farmer.

The meteorological division is extremely well equipped with many delicate and costly instruments so necessary in making accurate observations. Records of hourly temperature, rainfall, barometric pressure, wind velocity, etc., are made, and monthly summaries are sent to parties interested. The station is connected by wire with Washington, receives all predictions, and displays a complete set of weather signals.

A vast amount of work has been accomplished in the entomological department. The department is building up a collection of all insect pests in their several stages of growth, in order to aid it in determining with rapidity the names of the many different specimens sent to be identified. A bulletin which has met with great favor is the one treating of household pests, and the best remedies to be used against them.

A preliminary report has been made on the insects injurious to the cranberry. The subject is still under investigation, but it is thought wise not to publish any results till the investigation is complete. Much extremely careful and arduous work has been done in studying the habits of the gypsy moth, and valuable information obtained. An exhaustive report will soon be made to the State.

There is now in course of preparation a monograph with plates of the various grass-eating insects, so troublesome in many sections. A study of the elm-leaf beetle, together with methods best suited to check its depredations, will also appear in the near future.

In the horticultural department much study has been given to different methods of greenhouse heating and piping (see Hatch station bulletins, 4 and 6), with results quite decidedly in favor of the hot-water method. Considerable attention has also been given to the construction of greenhouses, with a view to embodying all the most desirable ideas, such as size of glass, arrangement of pipes and ventilating apparatus. All kinds of fruits for which any special merit has been claimed have been tested, and the results published. Experiments have been made with the different forms of apparatus and the most suitable solutions necessary to hold in check the various insect pests and fungi that prey upon fruit trees, vines and farm and garden crops (see Hatch station bulletins, 17, 25 and 29).

A very large number of field experiments has been carried out. A series extending over a number of years was conducted by Dr. Goessmann, to ascertain whether the so-called worn-out land that had been cropped for a long time with corn and grass was suffering from special or general exhaustion. These experiments, conducted on the station grounds, with corn, indicated that the soil was especially lacking in potash. A somewhat similar experiment was afterwards carried out on farms in different portions of the State by Professor Brooks; and in by far the great majority of cases the original results were confirmed. Such experiments have led the investigators to urge the use of fertilizers containing large amounts of potash. For corn four cords of stable manure and one hundred pounds of muriate of potash have been recommended. These experiments have led a step further, and called the attention of the investigator to the specific needs of different crops. Thus, in a rotation of five years, — corn, corn, oats, grass, grass, — it was found that the corn responded especially to potash; the oats and grass, which make a quick growth in the spring, to nitrate of soda; and the second crop, largely clover, to potash.

It is now known that leguminous crops have the power of taking large quantities of nitrogen from the air when the conditions are favorable. Experiments have been in progress for a number of years to see if, by alternating leguminous with grain crops, a sufficient amount of nitrogen could be gathered to produce a reasonable crop of the former, and at the same time sufficient nitrogen be left in the soil to support the latter, without the aid of any applied nitrogen. All of the eleven plots were fertilized with phosphoric acid and potash; some received various forms of nitrogen, and to several no nitrogen whatever was applied. In the cases where no nitrogen was given, the yield of both leguminous and grain crops was one-quarter to one-fifth less; the increased yield of the plots receiving nitrogen was not, however, sufficient to pay for its cost.

Experiments have been made to note the influence of sulphate and muriate of potash on the yield of garden crops. Potatoes, tomatoes, spinach, lettuce and onions seem to be quite noticeably more productive with the sulphate, while cabbage and beets show no particular preference.

Experiments are still in progress to determine the comparative values of different forms of phosphoric acid, as found in dissolved bone-black, South Carolina floats, Florida phosphate, Mona guano and phosphatic slag. In these experiments nitrogen and potash were applied to all the plats in equal and sufficient quantities yearly. Equal *money values* of the different phosphates were applied. At the end of four years' trial the value of the different forms of phosphoric acid, measured by their crop-producing powers, was as follows: 1, phosphatic slag; 2, South Carolina floats; 3, dissolved bone-black; 4, Mona guano; 5, Florida phosphate. The experiment is now being continued for another four years, without the further application of phosphates, in order to see how much of the phosphoric acid from each of the five different sources will be available for the growing crops. The results are not yet at hand.

To those interested in animal nutrition a concise statement of some of the results obtained will doubtless prove of interest. A series of feeding experiments with milch cows was instituted, in order to ascertain the comparative values of hay, corn stover, corn fodder (plant and ears), corn ensilage, sugar beets and carrots. It was found that corn ensilage and corn fodder produced pound for pound of dry matter a larger yield of milk at less cost than did a good quality of hay. Corn stover showed a feeding value approaching an average quality of hay, and should be properly cured and judiciously fed. Both sugar beets and carrots produced, per pound of dry matter, more milk than any of the above-mentioned coarse fodders, but at an increased cost per quart. In these experiments grain feeds rich in protein supplemented the coarse fodders. The experiments teach that hay, with a market value of fifteen dollars or more per ton, is too costly an article to be fed in large quantities by the majority of farmers, and that its place should be taken by corn ensilage and corn stover.

Many experiments have been tried with green crops, both for summer soiling and for ensilage. Vetch and oats, peas and oats, millet, and fodder corn have proved especially valuable and economical for summer feeding. For ensilage, medium green or black soja bean or Southern cow-pea have been found excellent for mixing with corn or millet, in the proportion of one part of the beans to two parts of the corn. The advantage of these leguminous crops lies in the fact that they increase the amount of protein or nitrogenous matter, and thereby lessen the necessity of feeding so much highly nitrogenous grain.

The large number of concentrated by-products that are now so freely offered in our Massachusetts market made it necessary to conduct feeding experiments with milch cows and digestion tests with sheep in order to get at their nutritive value. Old and new process linseed meals, cotton-seed and soja-bean meals, Chicago, Pope and King gluten meals, compare quite favorably with each other; all are valuable milk-producing feeds. Not more than two or three quarts of the Pope or King meal should be fed daily, because of the large amounts of fat contained in them. We have fed as high as four quarts of Chicago meal per day without causing trouble. Buffalo and Peoria gluten feed and Chicago maize feed have likewise been tested, and proved about equal in feeding effect. The following table may prove interesting, showing the approximate comparative *commercial values* of the different feeds *based on the amounts of digestible protein they contain:* —

	Per Ton.
Corn meal,	$21 00
Wheat brans,	18 00
Gluten feeds,	23 00
Gluten meals,	28 00
Cotton-seed meal,	30 50
New-process linseed meal,	29 00
Old-process linseed meal,	28 25

The above figures do not express the relative physiological effect of the different grains, but show rather their comparative values in digestible protein, after figuring the digestible carbohydrates and fat in all at a definite price. They can be used as guides in purchasing.

An investigation into the composition of cream from one hundred and sixty-five different farmers, raised by the deep-setting process, has only emphasized the unreliability of the "space" as a basis of payment. The amount of butter fat in such cream was found to vary from 11 to 22 per cent. The Babcock system, in which the cream is valued by the amount of butter fat it contains, should by all means be substituted. This method is now in general use in the western and northern States, and our Massachusetts creameries in neglecting to adopt it are most certainly shutting their eyes to progress.

A large number of pig-feeding experiments have been made to get at the cost of dressed pork, using skim-milk in combination with different grains. The results show that it is as a rule not profitable to feed pigs after they have reached 180 pounds of live weight. The cost of food required to produce a pound of dressed pork was about 5 cents. Skim-milk has returned ½ cent per quart, or 25 cents per 100 pounds, assuming dressed pork to be worth 6½ cents per pound.

Steer-feeding experiments were conducted for five years. The animals, ten in number, were purchased when thin in flesh, weighing 400 to 500 pounds, and sold after reaching a weight of 1,100 to 1,200 pounds. A great variety of fodder rations was tried. The most favorable results were obtained with corn ensilage, together with moderate quantities of Chicago gluten meal and wheat bran. The average gain in live weight per day during the entire experiment was 1.24 pounds, and the total cost of feed to produce a pound of live weight was 10.58 cents; while the total cost to us of a pound of live weight (obtained by adding to the original cost of the steer the cost of feed consumed and dividing by the pounds of live weight sold) was 6.89 cents. Five of the steers were pastured during the summer and five were soiled. The average daily gain of the soiled steers was 1.63 pounds, and for those pastured .63 pounds. The cost of feed to produce a pound of live weight in the case of the soiled steers was 8.75 cents, and in the case of those at pasture 7.30 cents. When animals are soiled the manure is retained on the farm, but the extra labor involved is considerable.

III. — The State and Hatch Stations united.

For several years it has been evident to many that, in order to avoid confusion, for purposes of economy, and to prevent a possible duplication of work, it would be better to unite the two stations. After much careful deliberation, the step was formally taken in April, 1895, the new combined station being known as the Hatch Experiment Station of the Massachusetts Agricultural College. The State station as such has ceased to exist.

The reorganized station is divided into seven distinct departments. The division of botany has been restored, after temporary suspension; the chemical work has been divided; and a new division, foods and feeding, has been established. The several divisions are as follows: —

Director,	President H. H. Goodell, LL.D.
Departments: —	
Agriculture,	Prof. W. P. Brooks.
Horticulture,	Prof. S. T. Maynard.
Botany,	Prof. G. E. Stone.
Chemistry (fertilizers and fertilizing material),	Prof. C. A. Goessmann.
Foods and Feeding (cattle feeds, water, dairy products and animal nutrition),	Prof. J. B. Lindsey.
Entomology,	Prof. C. H. Fernald.
Meteorology,	Prof. Leonard Metcalf.

I ask your attention to a brief outline of the work undertaken by the reorganized station.

Agriculture.

Experiments in plant nutrition will be continued, to note the special food requirements of various plants, as well as the different abilities which they possess to utilize the plant food of the soil.

Variety tests will be carried on, especially with fodder and grain crops, with a view of improving, by selection, their yield and quality.

The experiments in poultry, now under way, will be continued, in order to note the effect of various feed combinations on egg production.

Cultural experiments, such as depth of ploughing, subsoiling and methods of planting, will be conducted.

It is hoped, if time and money permit, to make tests of the comparative efficiency of different makes of agricultural machinery. A dynamometer will be employed, to note the amount of force necessary to draw different implements.

The agricultural department will co-operate with the chemical in continuing several important experiments already alluded to. These experiments include the alternation of leguminous and non-leguminous crops with and without nitrogen, the effect and economy of different forms of phosphoric acid, the effect of various forms and combinations of plant food upon the production of garden crops, and the value of a rotation of manures upon the yield of permanent grass lands.

Horticulture.

The work in horticulture will be continued on much the same lines as heretofore. It is planned, however, to test the many new varieties of vegetables so extensively advertised and highly recommended by seedsmen. It is hoped at no distant date to establish a seed control in connection with this department. Laboratories for this purpose are quite common in Europe at present. Such a step could not fail in improving much of the seed now offered for sale.

Botany.

In the department of botany several lines of work will be undertaken. A study of some of the diseases affecting farm and garden crops will be made. Tomato scab will be given careful attention. Various fungicides will be tested, especially those likely to prove valuable in greenhouse work. Applications of different solutions will be made to distinct numbers of plants, and the effect carefully noted for a considerable length of time. In the laboratory fungicides of different strengths will be inoculated with fungous germs, to see if the dilute solutions will admit of any fungous growth.

Greenhouse conditions will be carefully observed, to see what temperature, degree of moisture, barometric pressure, etc., favor the growth of different fungi. Such knowledge is absolutely essential in order to teach one the best methods of preventing the growth of these organisms.

Cucumbers will be grown in soil inoculated with nematodes; different methods of soil treatment will be tried, to see if practical means can be found to eradicate them.

Entomology.

The work will go on as formerly, the reorganization having in no way affected the department.

Meteorology.

The weather observations will be continued. Seven years' continuous observations are now being tabulated, in order to attempt to deduce some practical conclusions.

Chemistry.

The chemical work of the consolidated station has been divided. The control of commercial fertilizers, the analyses of all kinds of fertilizing material sent in, and the investigation of chemical problems in connection with field experiments, are in charge of the chemical department proper, conducted by Professor Goessmann.

Foods and Feeding.

This new department will test all dairy products, waters and cattle feeds at its chemical laboratory. The department is especially anxious to secure fair samples of all feed stuffs put upon the market, and the co-operation of farmers is earnestly desired. Attention will also be given to the improvements in methods of chemical analyses, and a considerable amount of time will of necessity be devoted to the chemical and physiological problems connected with the feeding experiments.

The department has the following experiments now in progress: —

(*a*) The effect of rations both poor and rich in protein upon the cost and quality of milk. For example, what quantity of nitrogenous feed stuff can be economically fed to milch cows without endangering their health? Again, do rations containing 2½ pounds of digestible protein produce a better quality of milk than those containing 1½ pounds, the total food consumed being in each case the same, and sufficient for the nourishment of the animal?

(*b*) An experiment will soon be instituted to get at the economical value of cotton-seed feed (1,600 pounds of cotton hulls and 400 pounds of cotton-seed meal, mixed) as a hay substitute for dairy cows.

(*c*) Experiments with sheep, to test the digestibility of gluten feeds, rice meal, millet and soja-bean ensilage.

(*d*) Experiments with pigs, to note the comparative feeding value of corn and rice meals for pork production. A constant quantity of skim-milk is being fed in connection with the grains.

The executive and administrative work of the station devolves upon the director, who also edits and has an oversight in the sending out of all publications. Bulletins are to be issued as heretofore. A summary of the contents, in plain, concise language, is to be placed first, and after that the explanations and details of the experiment. An annual report will be published, not exceeding one hundred and fifty pages in length. This report is to be made up of a summary of the work of the several departments for the year, and is to be as free from details as possible. The last part of the report is to be devoted to tables of analyses, expressed both in percentages and pounds. Any one who does not already receive the station publications has but to send in his name in order to secure them.

I have thus attempted, gentlemen, in the time at my disposal, to give you as comprehensive an idea as possible of what is being done for the benefit of the farmer at both the college and station.

In closing, I cannot do better than quote a portion of an editorial concerning the work of the agricultural stations of the United States, which recently appeared in one of our most intelligently edited agricultural papers.* This paper at times has seen fit to criticise — in all honesty of purpose, I believe — some of the work done at various stations in the country. It is as follows: —

Had the experiment stations of the United States done nothing else than furnish the Babcock test, they would have placed a large credit to their account. In addition to this, however, in the long line of researches that bear upon the economy of stock feeding, upon the combination and use of insecticides and fungicides, upon the elaboration and the use of chemical formulas adapted to individual soils, upon the saving and application of manures, upon the relation of foods to the composition of animals, upon problems of tillage, upon tests of mechanical appliances for all departments of the farm, upon the more exact data of dairying operations, upon questions of seeding and harvesting crops, upon drainage trials, and along other lines of art applied to husbandry, the stations have given useful information that, while not startling or apparently adequate to revolutionize farming, yet adds to the information that will enable us to make practice more precise.

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* "Mirror and Farmer," Nov. 14, 1895.

It is not probable that there lie either laws to be discovered or application of old laws that will rise in significance and stand as marked in the history of agriculture as the discovery and application of steam and electricity to the industries. Our industry is an old one, and the work of the investigator is that of patient inquiry into the domain of small things, with the expectation that at most each bit of information gained will apply to the relatively limited domain of farm practice, and affect the outcome of the products of each individual farmer but moderately. Yet increased knowledge in any domain may affect the income of the agriculture of the nation vastly. Thus any process that will increase the crop of corn by one per cent will make a difference of twenty million bushels of corn; it is evident that there can be applied a stimulus to our agriculture that might easily make a gain of 50 per cent, or add a billion bushels to our annual corn crop.

Our stations not only find facts for agriculture, but stimulate it. So long as the American farmer grows, as he does, vastly more crops per capita than farmers of any other nationality, it is fair to presume that he is a good judge of the efficacy of his educational forces. These forces he is supporting with increased zeal year by year.

The CHAIRMAN. An opportunity will now be given for questions. Please improve the time.

Dr. H. H. GOODELL (president of the Massachusetts Agricultural College). The ground has been so well covered that there is little I desire to say. But there is one point I want to bring out and that I want to explain to all here. Allusion has been made to the two years' course.

You will notice that it has not been outlined upon the chart. There is no one thing that the college has been so criticised for, by its students, by its alumni, by the people at large, as the establishment of this two years' course, but I do not believe, I cannot believe, that those who criticise it understand it. It is claimed that it is a simple catch-all for those men without brains who cannot stay in a four years' course; that they are dropped out of the four years' course into the two, and that there is no definite course laid down. That is utterly false. There are only two or three men (I think I am within bounds) of those who came to take the four years' course and were not well enough prepared to go into it who went into the two years' course, and no men have been dropped from the four years' course into the two years'. Our experience has been quite the reverse. Men have entered the four years' course from the two. The course as laid down is very much the same as that of the four years'. The course in agriculture touches exactly the same topics, only it is elementary; necessarily you cannot carry it as far as you can with those who are taking the four years' course.

There is a good horticultural course, a good course in veterinary. The elements of chemistry and mathematics are taught, and there is a first-class English course. You cannot expect to give in two years' time the same instructions that you can in four. The course was established to give a chance to those young men who have not the means or time to spend four years in college. Is not that working in the very interests of agriculture? Is not that working in the interests of the farmer? Those farmers who cannot send their boys to take the full course can give them the two years' course.

No allusion has been made to the dairy course, for the reason that it is not yet established. The course will be submitted to the committee on course of study and faculty probably next week. It is a dairy course of three months, lasting from January through March.

A very great pressure has been brought to bear upon us during the last year or two to change the course and introduce mechanical and scientific courses. We should then lead students away from agriculture, and make agriculture, the very thing the college was founded for, simply an elective study. We have resisted this pressure as far as practicable. The college was founded for agriculture. The State has put into it a large sum of money for that purpose and nothing else, and we cannot conceive it right to deviate from that purpose. Tuesday night the remark was made that it was the aim of the Board and the grange to uplift the farming class. The college ought to have been included when they were mentioned. In connection with that, I happened to read this morning a sentence from the address of that eloquent colored man, Prof. Booker T. Washington, at Atlanta, in which he says: —

> No race can prosper until it learns that there is as much dignity in tilling a field as in writing a poem. Our greatest danger is that we may overlook the fact that the most of us are to live by the product of our hands, and fail to keep in mind that we shall prosper in proportion as we learn to dignify and cultivate common labor and put brains and skill into the common occupations of life.

The aim of the college is to try to teach the boys to put brains and skill into everything they undertake. The Society in New York for the Relief of the Poor has issued a series of inquiries in regard to the agricultural depression in New York State. The first leaflet has just been published, and in it there is this very significant statement: —

> While travelling through the agricultural districts, Mr. Kjelgaard, in reaching the vicinity of Ithaca, N. Y. (where Cornell University is and where the experiment station is), found a condition of affairs prevailing among the farmers in that locality that seemed pre-eminently significant. It is true that here also there was a shrinkage of values in farming property, as compared to the high prices of twenty-five years ago, but the depression was comparatively small. There was an air of prosperity about the farmers not found in other sections. The farmers were full of hope, and their children expressed their determination to remain in the country and follow an agricultural life. The reason for

this singular contrast with other sections of the State is discovered in the location at Ithaca of one of the United States government agricultural experiment stations. To quote from Mr. Kjelgaard's report: "All are agreed that the station is a help to them, and the entire conditions here are different. Not only this, but I find that the indirect influence of these institutions was greater even than the direct. I also found that not only in the vicinity of Ithaca, but one hundred miles away, a man who had taken a course of agricultural training at Cornell University was carrying the benefits of his knowledge into his neighborhood. His neighbors, seeing how superior his methods are to theirs, are quick to profit by it. This led to the investigation as to whether the same condition prevailed in the vicinity of other agricultural colleges and government stations. The inquiry proved that they are all bearing excellent fruit."

When I look around among our graduates, our alumni, and see the situations they are occupying, not only in this State, but throughout the country, as has already been said, as college presidents, as college professors, directors of stations, as assistant directors, as superintendents of farms, as farmers, as veterinarians, as chairman of the cattle commission, as instructor in Harvard University and in Yale, — I am not ashamed of what the college has done or the influence it has exerted. Twenty-seven years has been my apprenticeship at the college, and I hope to live to see the day that its influence will not be in fifty miles or one hundred miles, but all over the State.

Mr. Chas. E. Ward (of Buckland). This Board has been the recipient of courtesies almost innumerable from the citizens of Dalton. While we have attempted, by lecture and discussion, to show the need of skill and intelligence upon our farms, we have been given object lessons, showing their power in factories. As we have discussed the plain, prosaic questions of agricultural life, we have been surrounded by an artistic display of ferns and flowers such as can never fail to awake the highest emotions and aspirations in man's nature. Our members have been given carriage drives to distant objects of interest. At the reception given the Board a large number of these citizens testified by their presence to their interest in our work. In this enumeration we would by no means forget the songs which we have heard, — the sweet and cheering influence of the power of song, God's greatest gift to his children, has been given us in a manner which we shall never forget. For all these reasons I move the adoption of this resolution, and that it be placed upon the records : —

Resolved, That the Board of Agriculture, mindful of the many courtesies it has received from the citizens of Dalton, hereby conveys to them its earnest and hearty thanks.

The resolution was unanimously adopted.

The CHAIRMAN. I would ask Mr. Barton to be kind enough to let this be known in his own way.

Mr. H. A. BARTON (of Dalton). I want to say a word in regard to the resolution. It has been very gratifying to me, as well as to every citizen of Dalton, to have you come here, and we appreciate very much the honor you have conferred upon us in accepting our invitation. We have desired to make it a very pleasant stay ; and if when we go back to our work we may carry not only pleasant recollections but may be more faithful in our work in every department, and fill the place that we have already gotten and "a little more," then the citizens of Dalton will be grateful again.

Mr. J. H. HALE (of South Glastonbury, Conn.). I have been particularly interested in the paper this morning, and also in the remarks by the president of the Agricultural College. As I listened to the essayist, my mind has gone back to my early boyhood on the farm, when no such opportunities as are now given to the farmers' boys were available ; and it seems to me that the farmers of Massachusetts and New England where these colleges and experiment stations are located ought to feel that we are particularly blessed in the opportunities that come to us. When the president of the college was so eloquently telling of the work of his boys that had gone out, and what they are doing, — as he mentioned their being college presidents, experiment station directors, farm superintendents, etc., I thought of my own experience in this line, and perhaps a hint thrown out by the lecturer will give some reason for it. Starting with a small New England farm and working our way along as we could, the time came when we needed additional help, when we needed brains as well as muscle. I have had more or less of college boys to work on the farm, and I have tried to lead them up into farm superintendents. Branching out and going South, it became necessary to have a farm superintendent, and, while I have had a great many boys from college, I have not yet found one that made a real good, efficient superintendent. The boys that are not smart enough to make a living on the farm they send to college.

President GOODELL. A man may be a first-rate scholar, and not know how to handle men.

Mr. HALE. I want a good farm superintendent; I will pay him all he is worth. In my operations I have always been a good deal of a crank on fertilizers, and, with more than a thousand acres under the plough at the present time, it is a very important problem with us. I thought of the successful town we have here and of the successful manufacturers, and the thought came to me that in these great mills, where there is so much at stake and where so much is being spent yearly, if some chemist should come along and say that he could take out of yonder stream what they are paying twenty or thirty thousand dollars a year for, they would say, "Mr. Chemist, go at it; show us how it is done." They would pay almost any amount of money to gather out of the stream what they are paying thousands of dollars for. The stations have said, "Fellow farmers, you are paying fifteen and twenty cents a pound for what you have right on your own land, and you keep on paying that price. Don't you need the money as much as these manufacturers do? Is farming so good a business that you do not need to listen to these things?" The trouble, it seems to me, is that the farmers do not grasp the situation, do not take hold of it. I have not done one-quarter as much as I ought. I have sometimes turned in as many as fifty acres in one year. I do not mean to have an idle acre of land in the summer. I cannot afford it. I am poor. I have got to save all I can. These nitrogen traps are most valuable to us, but we would not have known it if it had not been for the stations. We put it into practice, and find it is a good thing. It seems to me the farmers do not grasp these things. Perhaps it is because farming is too good a business. Perhaps we are fixed as the old farmer I heard about a short time ago. An agent for an aqueduct was travelling in the country. The apparatus was working nicely, and he was selling them and making lots of money. One day he struck a fine farm. Everything was in first-class shape except the water supply. He thought, "Here is a chance to sell an outfit." He introduced himself to the farmer, and talked about the farm; then he tackled him on the water problem, and told him what he could do. The farmer said: "Yes, young fellow, I guess that is all true enough; guess the works are all right; but somehow I do not believe I will invest. I came way up here in the woods in my early boyhood days and cleared away a little timber, built a log cabin; a child was born to us, and I cleared away a few more acres; health and happiness came to us, the Lord has smiled on us and we are content and happy; and I do not feel like asking him to pump water."

The nitrogen is there, free. You ought to have it, and you can have it if you will. We ought to go to the colleges more. It will help the colleges. The scientific fellows do not know it all. By coming in contact with the farmers they can get an inspiration that will help them, and it will help us; it will do us a heap more good than it will do them. Let us profit by what they know.

Mr. A. Pratt (of North Middleborough). I would like to ask Dr. Lindsey if I understood him that from ten to twelve hundred dollars will carry a boy through a four years' course in college.

Dr. Lindsey. A young man can get along with less money than that. I attempted to give the average figure which I think any of them can get along with.

Mr. Pratt. I often hear the mournful cry from farmers of my age and older, "What is to become of our farms after we get through with them? We must get through with them soon." Such farmers hold from one to three hundred acres of land, some less. I have often thought wouldn't it be economy for those farmers holding so large an amount of real estate to dispose of half of it and send their sons to college, — this college which is so well equipped to prepare them for the business which they will make a success of. I am very much interested to learn that so large a per cent of those that enter the college pursue the work of agriculture. If I understood you, over one-half make that their business; and I believe, if they commence it after a four years' course in your college, that they are prepared to carry it on for life and make a success of it. I have often thought that if I could have had when a boy the privileges of the college as it is equipped now, I could have been a good farmer. Yet the college has had to struggle for existence. I was in the Legislature when the first appropriation was asked for. It was ridiculed. To-day see the contrast. Within a few miles of my place is a young man who undoubtedly if he had remained at home without entering your college would not have been even an ordinary farmer. To-day, after graduating from your college some years ago, he is holding the position of president of a college in an adjoining State, and I understand is a very efficient officer. I do not believe that our farmers appreciate the college. They may in this section of the State, near where it is located, but not farther away, where I am. I do not believe they realize how much you are doing, how well you are prepared to take their sons and make them more successful as farmers. I often hear it said that if a young man were to start now on a farm and undertake to make farming his calling for life it is doubtful whether he could make a success. It may be true, if he intends to follow along in the ruts that his father has followed. But let him go and prepare himself, and it seems to me that there is no better opening for a young man than to enter your college, take a full course and start out in life on that pleasant occupation, — farming.

Professor BROOKS (of Amherst). Mr. Hale has undoubtedly heard the expression that "some men are born to command." What proportion of those that are born are born to command? There are but few, and even those who are born to command require considerable experience before they are fit to command. These facts should be remembered before forming conclusions as to the results of the work of the college. There are some men who are willing to pay what a man who is born to command is worth. Most men, in making a contract with such a man, are not too liberal. Then, further: these men who, like Mr. Hale, are born to command, cannot afford to go into the employ of others. They can do infinitely better for themselves. A young man who graduated a few years ago (it was my privilege to help him a little when he left) came to me a short time before he graduated, and said that he wanted to become a market gardener. He said: "I have decided that that is the best thing for me to do. I want a little experience in actual market gardening, and to get hold of the business side of it a little more fully than it is possible to do in a place like this." (You cannot expect us to teach the business side of it.) "Do you know of any such place? I want to work hard." Fortunately, I did know. I got him the place, and he went to work. The owner is a farmer seventy-five years old, and his three sons are the most successful market gardeners anywhere near Boston. I have this information directly from them. The first morning, when he went to work, there was a slight joke among the men, "He will be pretty tired about night." He was strong, and worked all through college, and it did not cost him anywhere near a thousand dollars; he came pretty near paying his own way. You may be sure he was tired when night came, but the other men were tired trying to keep up with him. So he went right along in that way, and the next spring he felt that he was ready to go to work for himself. He went to the old gentleman and told him that he had decided to go to work for himself. The old man told him, "I do not want to discourage you in that, but we shall be very glad to keep you, and can afford to pay you well, but I think it will be better for you to go to work for yourself. If you need any capital to help you get a start, we will let you have any amount you need." I do not know to what extent he availed himself of that offer, but he went to work for himself, and he is now ready to buy and pay for a farm near Boston. I had that from him when I travelled with him going to the Bay State fair in Worcester only a few months ago. That is what a man of the right stuff can do at Amherst, but they are not all like him.

Mr. F. E. Clark (of Wilbraham). You remember a year ago last June the Board of Agriculture was invited to visit Mr Hale's strawberry and peach plantation in Glastonbury, Conn. While there he told us of his experiments with clover. If I recollect, he said something like this: "If Mr. Bowker were not here, I would tell you that for ten or twelve cents I can produce as much nitrogen and save it for my farm as I can buy from Mr. Bowker for the same number of dollars." I was so much enthused that I came home and told members of our grange about it; and I sowed crimson clover, and a good many of my neighbors did, and last fall it came up and looked nice, but in the spring it had almost all disappeared. We found a few sprigs of it, and took them into the house and our wives put them in their flower pots. I would like to ask Mr. Hale if he still continues to have success. If so, is it not the difference in the temperature that makes it winter-kill with us?

Mr. Hale. If the gentleman has read as he should, he will find that scarlet clover was killed throughout the whole United States last winter, — in Delaware and Virginia, where it was first introduced and was grown so successfully, and in Connecticut, Massachusetts and New York, — wherever it was tried; and still I keep right on with it. I lost more last winter than ever before. There is no doubt that it is a little bit tender, but it is becoming acclimated and is growing more hardy. Instead of carrying those plants to your best girl, you should have saved the seed. Some use red clover. It takes a longer season. The red clover is not ready to bloom until into June, while the scarlet is ready in May. Grow the common clover or the cow-pea or the soja bean; do not give up the trap.

Professor Brooks. What the experiment stations publish is not read enough. Crimson clover has not been successful as a nitrogen trap at the experiment station in Amherst. Last winter was in Massachusetts an exceedingly favorable one for it. The snow came early, and afforded a protection for it. It is not the severity of the winter that kills it, it is the long period of alternate freezing and thawing in the spring, and before real growing weather comes it is dead. I believe that something can be done to increase its hardiness.

The CHAIRMAN. I want to recall what Governor Hoard said. He said that we farmers were manufacturers, to which Governor Greenhalge readily assented. We should economize in every possible way to make our profits; and as we have been through these mills we have been struck with the idea that the people are surrounded with such good circumstances, good air, good light. We want those who work on our farms to have good sanitary conditions. The refuse product of the mills was sold; some use was found for it. Every possible economy was practised there, and we want to adopt that same plan.

Mr. T. S. GOLD (secretary Connecticut State Board of Agriculture). Governor Hoard has previously spent with us a whole hour upon the advantages of using peas and oats together for supplying our stock and at the same time bringing up the land. The pea crop is found to be the most valuable nitrogen gatherer in the whole list. It will help you to clean your farm from weeds, for it will drive them out or smother them, and leave the land in a very clean condition. In addition to that, it furnishes a most valuable food, either in the green state or dry, for your sheep, neat stock, swine or other animals on the farm.

President GOODELL. Mr. Pratt spoke of the good outfit at the college. The college is only in a growing condition when it wants something. I suppose we shall keep on growing and wanting something all the time.

Mr. BARTON. I should not think I had done my duty if I did not say a word in regard to the college. A few years ago my son and my nephew entered the college. I wish to express to the president and all the friends of the college his gratitude and mine for the splendid help that college gave him and his cousin. An opportunity came to them for business, — not on the farm, — and they have taken it up. And constantly when I meet those boys, as I did a short time ago in Buffalo, they always speak of the agricultural college and of the earnest effort exerted there by the college faculty to help the boys; and I am very glad to give their testimony here this morning. A friend of mine in the back part of the hall said to me a few moments ago: "A German family bought a farm and agreed to pay seven thousand dollars for it, and it was not worth over three. They found that it was drifting out of their hands, and it would soon all be gone. Their boy went to the college at Ithaca, N. Y. He staid there a few months, at an expense of ninety dollars, and came back home; and that boy with his father has paid off all the debts, simply by the instruction which he received there, and they are now successful and doing well." I speak of that instance to show that this training helps the right kind of boys. If we want good men in the factory or on the farm we must take those who are anxious to improve, or they will not get higher. If a person wants to be promoted, let him fill the place that he is filling and a little more, and somebody will want him every time. Those boys may not be fitted to command, but they are a mighty sight better for going to the college, and will fill a much higher place than they would have had they never gone.

Mr. W. M. Tucker (of Monson). I do not want to let this opportunity pass without saying a word. I believe that the farmers who come here or to any other meeting of the Board, if they ask any questions of the professors or of the president of the college, will get a good straight answer; and, as it has been said, if they do not read the bulletins that are sent out, it is not the fault of the college if they fail to find out what they are doing. I must say that it was my privilege to attend the college but a short time. The condition of the health of my father prevented it. If I had taken the full course, perhaps I should have been something more than a common farmer, and might have had a higher position, — been an uncommon farmer.

Adjourned at 12 m.

AFTERNOON SESSION.

The Board met at 1.40 P.M., Mr. GRINNELL presiding. After singing by the Oberon Ladies' Quartette, the chairman said: It gives me great pleasure to introduce to you Dr. OSGOOD, chairman of the Board of Cattle Commissioners, who will speak to us this afternoon on the subject "Rational stable management."

Dr. OSGOOD. Mr. Chairman, ladies and gentlemen: Some two months ago I determined that I would make some examinations to determine under exactly what hygienic conditions our animals are kept. As a result of that work, I was surprised, I might say, at the condition of the water our animals drink and the air in which they are confined. The examinations extended over some twenty-five farms, located in fifteen different towns.

When I noticed on the paper sent me by the secretary that my subject was to be "Rational stable management," I was a little surprised. My idea was to talk to you more upon hygiene than stable management, as that is too broad a subject to think of covering in one afternoon. I shall, however, take one or two of the fundamental necessities, in order that we may establish a rational stable management. Those two fundamental principles, then, will be water and air.

RATIONAL STABLE MANAGEMENT.

BY DR. F. H. OSGOOD, BOSTON.

Mr. Chairman, ladies and gentlemen of the State Board of Agriculture: When I received your very kind invitation to address you at Dalton at the public winter meeting of the Board, I was just about completing some analytical work in the field, with a view of ascertaining the exact conditions under which our dairy cattle are kept. The results of this work extended over 15 different towns; 25 barns were examined; the largest number of animals in any one barn was 60; smallest number, 1; average, 20.

The number of cubic feet air space per head varied from 300 to 2,500, the average being 750 cubic feet per animal.

The carbon dioxide in 10,000 feet of air varied from 6 parts to 14 parts, the average being 8.6 parts in 10,000 parts of air. The number of bacteria in 10 litres of air varied from 140 to 1,130, the average being 424.

From an examination of the water upon these premises, 56 per cent was found to be in good condition, 20 per cent in fair condition and 24 per cent in bad condition. The air was found in good condition in 12 per cent of the barns examined, in fair condition in 48 per cent, in bad condition in 40 per cent.

In reviewing your notice of the meeting, I see that the subject of my paper is designated as "Rational stable management." This, however, seems too broad a field to cover in so short a space of time, and I shall confine my attention to a consideration of two of the fundamental essentials to a "rational stable management." These are, a pure water supply and a sufficient quantity of pure air.

Dr. Parkes, the founder of modern hygiene, a man who has contributed more to the saving of life than words or figures can express, tells us that, if we had a perfect knowledge of the laws of life and could practically apply this knowledge in a perfect system of hygienic rules, disease would be impossible. That such perfect knowledge is not likely to be obtained, or, rather, if obtained is not likely to be acted upon, we can have no reasonable doubt. He has, however, defined hygiene as "the art of preserving health." It aims at rendering growth more perfect, decay less rapid, life more vigorous and death more remote.

We have, in dealing with this subject, to consider, with regard to animals, the air they breathe, the water they drink, the food they are fed on, the stables they are placed in, the soil they live on, the exercise and labor that they undergo, their individual care and management, and, lastly, the prevention and eradication of the infectious and contagious diseases from which they suffer.

WATER.

It is only within recent years that the necessity for a supply of pure and wholesome water for man has been recognized. Before the light of scientific investigation into obscure causes of epidemic diseases was brought to bear, but little attention had been paid to the subject. People drank surface water from polluted rivers and ditches, or from wells in close vicinity to cesspools and other receptacles for decomposing organic matter, and such a thing was considered by no means dangerous. Science, however, has shown that a large body of people cannot with impunity drink water containing the essence of their own excreta, and considerable light has of late years been thrown upon the diseases which are introduced by the agency of impure water. Respecting the part played by impure water in the production of disease among the lower animals we have at present very little evidence. I think it is undoubted that man suffers from more disease as the result of this than do the lower animals; but I am equally convinced that horses and cattle, no less than their masters, require, for the most perfect bodily condition, a pure and wholesome supply of water. However that may be, as a simple matter of hygiene, it is our duty to obtain for animals a supply as pure as is consistent with circumstances.

The characteristics of a pure water are absence of color, taste, smell or extreme hardness. Impurities found in water are of various kinds, but may be generally stated to be organic or inorganic. The organic impurities are small and vegetable substances in all forms, from disease-producing matter to harmless vegetable growths. The inorganic impurities are the salts of the metals.

These impurities obtain entrance into the water in various ways, either at its source or during its passage through rivers, canals or pipes, or even after its delivery to the place of consumption. The impurities obtained at this origin will depend upon the geological formation of the soil in which the source is situated. If the ground is charged with the products of animal excreta and refuse, the water derived from it will contain these products in solution; but it is evident that some soils or formations are more impure than others, and this difference in the degree of soil impurity depends upon the power the ground possesses of oxidizing or destroying the filth which is carried into it. Where rapid destruction of this occurs, there we may expect to find a purer water than in formations where it does not. Moreover, the porosity of the soil, especially when of great depth, will considerably assist in purifying the water by acting as a natural filter.

It is evident that in deep, porous soils, where rapid oxidation and destruction of organic matter occur, we may look for water of a pure type, and the more we depart from these conditions the more impure will be the water. Again, the presence of the salts of metals in great abundance in the formation will affect the purity of a water; for we find that these substances, such as lime, magnesium, soda, potash, iron and alumina, are very readily acted upon by the water passing through the soil, and rapidly taken up in solution.

In gravel formations we usually expect to find a pure water, particularly away from towns. Where clay exists the water is usually impure; in alluvial formations it is generally bad; in limestone and chalk districts the water is, as a rule, organically pure, but contains a large amount of mineral substance, as lime and magnesium, rendering it exceedingly hard. Surface waters, especially from cultivated lands, and marsh waters, are usually very impure, from the amount of organic matter they contain.

The impurities found in wells are derived from surface washings and soakage through soil impregnated with organic matter; from pipes or cesspools containing animal excreta, and the leakage finding its way into the soil to be carried into the nearest well. Shallow wells near buildings or stables, or close to manure pits, are simply receptacles for filth.

Dissolved Solids.

We have now to consider the chemical examination of the water for dissolved solids. These consist of lime, magnesia, soda, potash, ammonia, iron, alumina, combined with chlorine, sulphuric, carbonic, phosphoric, nitric and nitrous acids. Let us clearly understand, before we proceed further, what the object is of determining the presence of these substances in water. We may rightly argue that the addition of them to drinking water would, in the small quantities in which they are found, be utterly unproductive of harm. Perfectly true. We might add all these substances in the proportion in which they are found in bad water, viz., only fractional parts of grains, and yet not in the least impair the purity of drinking water. Why, then, does the chemist lay such stress upon their presence, and what is the object of the careful and often tedious process for isolating each substance and estimating its quantity? The object of this is that the elements, as we obtain them, are indications of the compounds in which they exist, and are undoubted proofs of the entrance into the water of substances containing these elements.

If we look back at the whole range of organic and inorganic substances, we shall find that there are but few of them which do not contain the elements and acids we have named. They may be found in the earth, and in animal or vegetable bodies. Their presence, therefore, in water, is from either one or all of these sources, — it remains with the chemist to decide which. Take ammonia, as another example. Consider how few substances there are in nature which do not contain either ammonia or the elements which form it. Rain water collected before it reaches the earth contains a distinct amount of it; nearly all organic substances contain either it or its elements, — nitrogen and hydrogen. Would we, therefore, be justified in rejecting uncontaminated rain water because it contains ammonia? Certainly not, for we know its source and origin. What is it, then, which renders us suspicious of ammonia in water? It is not its quantity, for even in sewage it seldom reaches more than 1.6 parts in 10,000, and we know that therapeutically we can give it, combined with a carbonate, in the quantity of drachms. It is evident, therefore, that it is not ammonia which we fear, but it is the undoubted indication which the presence of ammonia affords us of organic contamination. We cannot isolate fæces, urine or putrid organic substances in water in the form in which they entered, for they have become dissolved or suspended; their elements have undergone change; the nitrogen has broken up or combined with hydrogen, and thus formed ammonia. In ammonia, therefore, we have our index of the amount of organic nitrogenous substances in drinking water, and in speaking of ammonia we are actually speaking of organic nitrogenous matter.

We have named chlorine also as a substance to be sought for. Now, chlorine in the form of gas, or dissolved in water, is certainly a powerful germicide, and consequently it might be argued that in the very small proportion in which it is found it would be beneficial rather than otherwise. But the chemist shows us clearly that the chlorine does not exist in drinking water in a free state, but in combination with other elements which render it of less value as a germicide, but, on the other hand, make it a most valuable aid in detecting impurity; for the chlorine found there comes only from two sources, viz., chlorides of the metals, potassium, calcium or sodium, or chlorides of the same bases contained in organic substances. It is certain that chlorine derived from the chloride of sodium of inorganic substances is quite harmless, and it has been suggested that thirty to forty grains per gallon might be added to drinking water with positive advantage. But, on the other hand, chlorine derived from the chloride of sodium of urine and fæces would be a very serious thing. We determine the chlorine, therefore, to see whether urine or other organic matter has obtained entry into the drinking water; we know the normal amount of chlorine which should exist, and all over and above this must either be derived from organic matter or from a salt stratum.

It must not be inferred that the amount of contamination of a stream, as indicated by the excess of chlorine over the normal of the region, is necessarily the result of *direct* access of sewage to the stream. The amount of chlorine in a stream above the normal is in direct proportion to the population on the area on which it is drained, whether the region has sewers or not; provided, of course, that the sewage is not carried outside the drainage area. But with regard to the organic matters the case is very different. When sewage flows directly into a stream, there is direct pollution of the water by decomposing organic matter; whereas, when house drainage reaches the stream, after filtering through porous earth, the organic matter may have been entirely oxidized, and the water be purer, organically, than the stream into which it flows. But the chlorine in the waste waters suffers no change in filtering through the earth, and hence this evidence of "previous pollution" remains to tell the origin of the water.

Nitrogen as Nitrates and Nitrites.

The oxidation of ammonia which goes on in natural waters under the influence of micro-organisms results in the conversion of all of the hydrogen into water and the nitrogen into nitric acid, which combines with soda, potash or lime in the water. Intermediate between the ammonia and nitric acid is nitrous acid, a lower state of oxidation, through which (presumably) the nitrogen must pass before it attains its highest stage of oxidation. The combinations of nitrous acid with bases are called nitrites; those of nitric acid with bases, nitrates.

High free ammonia and high nitrites together are characteristic of recent pollution, and when they are uniformly high in a surface water they point to continuous pollution. When, however, the chlorine is not much above the normal in waters which show high free ammonia and nitrites, the inference to be drawn from these products of decomposition is that we have to do with pollution from farm-yards or from manured fields, — a distinction which it is frequently very important to make.

Deductions drawn by the chemist are based upon the fact that, in waters where the chlorine is due to organic contamination, he finds present at the same time free ammonia as well as nitrites; or, in other words, where all three are found present in any water in a degree much in excess of the normal, it is an indication at once that it is from a contaminated source, and not fit for consumption. In our work upon the investigation into the sanitary condition of our farm buildings we have made analyses of some twenty-five samples of water, taken from a large number of towns. The results of these analyses show as follows: —

Water Analysis.

NUMBER.	AMMONIA.		Chlorine.	Nitrites.	Condition of Water.
	Free.	Albuminoid.			
1, . .	.0010	.0160	0.69	.0003	Good.
2, . .	.0012	.0212	0.74	.0005	Good.
3, . .	.0012	.0084	0.22	Free.	Good.
4, . .	.1600	.0090	1.23	.0042	Bad.
5, . .	.0024	.0156	0.43	Free.	Good.
6, . .	.0017	.0070	0.30	Free.	Good.
7, . .	.0540	.3700	6.60	Very high.	Bad.
8, . .	.0008	.0021	0.68	Free.	Fair.
9, . .	.0034	.0046	0.36	Free.	Good.
10, . .	.0048	.0036	0.88	Slight.	Fair.
11, . .	.2100	.0820	24.29	.0048	Dangerous.
12, . .	.0036	.0060	0.63	Free.	Good.
13, . .	.0126	.0068	0.20	Slight.	Fair.
14, . .	.0022	.0015	0.26	Free.	Good.
15, . .	.0116	.0034	2.70	Slight.	Bad.
16, . .	.0003	.0024	0.35	Slight.	Good.
17, . .	.0072	.0042	1.80	Trace.	Fair.
18, . .	.0320	.0105	8.16	.0047	Bad.
19, . .	.0076	.0038	0.62	.0034	Fair.
20, . .	.0144	.0026	0.49	.0004	Good.
21, . .	.0002	.0016	0.87	None.	Good.
22, . .	.0144	.0120	3.00	.0042	Bad.
23, . .	.0014	.0020	0.46	Free.	Good.
24, . .	.0006	.0070	0.13	Free.	Good.
25, . .	.0028	.0180	0.70	.0005	Good.

Effects of an Impure Supply of Water.

We are in almost absolute ignorance as to the effects of an impure supply of water on the health of animals; the general impression, that any water is good enough for horses and cattle to drink, has perhaps to account for this state of affairs; there can, however, be no doubt that, as precise investigations proceed and greater care is shown in the inquiry into and accuracy of examination of the causes operating in producing disease amongst animals, impure water will have its legitimate share allotted to it. Of one thing I am convinced, that, however inert impure water may have been to animals in a wild state, the more we subject them to an artificial existence, as the result of civilization, the more we remove from them the immunity they may have possessed against common causes of disease, and the greater the liability there is for causes which originally may never have existed to become developed.

What are the substances in water which are liable, then, to provoke disease? We have animal organic matter, vegetable organic matter, particularly that of marshes, the germs of specific diseases and some of the salts.

Commencing with the latter first, we know the result on the digestive organs of horses receiving a large quantity of lime in their water. Hard water undoubtedly produces a derangement of the intestinal canal, and sympathetically of the skin; the harsh, staring coat of horses receiving hard water rapidly disappears when a softer water is supplied. The amount of hardness in water which will produce this derangement of the intestinal canal has not been accurately determined; but from eight to ten grains of lime per gallon has, in many cases, been found injurious.

Water impregnated with sulphurous acid gives rise in cattle to a number of serious symptoms and to diseases of the bones. Water highly charged with calcium carbonate and sulphate has been found to give rise to exostoses in horses, and on pure water being substituted the disease ceased.

An excess of sulphate of lime in the well water is supposed to have caused an epizootic amongst the horses of a French regiment of cavalry. On changing the water supply the disease ceased.

Butyric acid, one of the results of the decomposition of organic substances, has been known, in combination with lime, to produce diarrhœa in man and animals.

Cystic calculi among animals, particularly sheep, have been attributed to the excessive hardness of the water. Calculus disease is more common in the limestone districts than in any others. Goitre has been observed amongst horses and mules in France from drinking waters well known to produce goitre in man.

The impregnation of water by sewage has undoubtedly some effect upon animals. Mr. Stevenson, veterinary surgeon of Newcastle-on-Tyne, regards it as the most prolific source of abortion in cows, and abortion in ewes has been attributed to the same cause. We have no idea how much it may be answerable for causes of intestinal irritation, such as diarrhœa; or of obscure outbreaks of disease which we read of from time to time. It seems, at least, only rational to assume that it must have some evil effect, and as our knowledge progresses we shall have outbreaks of disease clearly attributable to this cause.

We have, at least, very clear grounds for stating that most of the specific diseases from which animals suffer may certainly be communicated through the water supply. I need only instance glanders, foot-and-mouth disease, anthrax and tuberculosis.

How far cases of sore throat, particularly that known as the malignant type, may be due to impure water, we have no positive knowledge as yet.

Lastly, water may be, and perhaps in animals is, the most common medium for the conveyance of the ova of parasites; tape-worms, liver-fluke, round-worms and thread-worms are undoubtedly conveyed in this manner.

The amount of organic matter in water given to animals to drink is often very high. I need only allude to the water supply of farm-yards from pools and ditches; the water is stagnant, putrid, swarming with animal and vegetable organisms, the result of the impregnation with animal excreta and farm-yard refuse. The flesh and milk from animals receiving water of this description have often a bad taste and peculiar odor.

I have entered rather fully into the subject of water, for the reason that I am persuaded we have many diseases affecting horses and cattle, particularly the latter, which are due to its influence.

There can be no doubt that for the full enjoyment of health an unlimited and pure supply of water is necessary; and, though the effects of a bad supply may not produce in many cases any positively prejudicial effect, such as we can see, yet it must be a means of exposing the health of animals to risk, by lowering the tone of the system, and rendering them more susceptible to contract zymotic poisons when these are present.

Impurities in the Air.

It is not surprising to find that the impurities found in the air are numerous, and derived from many sources. The importance of these impurities is very great, when we consider that, in whatever form they exist, they obtain a direct entry into the animal's body by means of the respiratory passage.

The lungs of a horse will contain nearly one and one-half cubic feet of air, and at each respiration about one hundred and forty cubic inches are drawn through the trachea; the surface of the lungs to which this amount of air is exposed is calculated to be equal to two hundred and eighty-nine square feet. Air, then, containing impurities, is exposed to an absorbent area within the body equal to five and a half times the surface of the skin.

Air is rendered impure by the products of respiration and the decomposition of excreta; for convenience of description, therefore, the impurities of air are divided into organic, inorganic and gaseous.

Organic impurities, in small proportions, always exist in the air of places occupied by animals.

Organic impurities exist in the form of solid particles, accompanied in many cases by gases which are given off from them. These particles, such as bacteria, spores or fungi, are only of microscopical dimensions; others, such as vegetable fibre, epithelial cells, etc., are much larger.

We know very little about these living particles of matter found in the air; they are largely met with in hospitals, houses and stables, wherever the air is impure, and in a lesser degree they exist everywhere. We can filter them from the air, and can also destroy them by the action of chemical agents. On this process of filtration and disinfection of organic particles is founded the basis of antiseptic surgery.

Among these organized particles are also others, which form a distinct group. They are characterized as being the *materies morbi*, or disease-producing bacteria; such, for instance, are the poisons of pleuro-pneumonia, tuberculosis, sheep-pox, cattle-plague, influenza, and probably anthrax and glanders. That particles of disease-producing matter can be conveyed by the air is well known. Epithelial scales and pus-cells have been found in the air of hospitals, and in those devoted to the treatment of skin diseases actual disease-producing fungi have been found.

When particles exist in the air surrounding diseased animals, it is only rational to believe that in the case of infectious diseases they may be the means of conveying the specific poison.

Various forms of bacteria have been detected in the air; putrefactive bacteria are always present; those of anthrax, tuberculosis and glanders are probably present under certain conditions, — particularly those of tuberculosis.

The organic matter found in air vitiated by respiration and transpiration is made up of cast-off epithelium from the mouth, air passages and skin; organic vapors from the lungs and skin, whose constitution is imperfectly known; fæces, in fine division; and vapors derived from the decomposition of materials from the intestinal and urinary passages. This organic matter is accompanied by carbonic acid gas and watery vapor. Regarding the latter, the cutaneous and pulmonary transpiration from a horse, whilst in the stable, is equal to about two gallons of water in twenty-four hours; for the ox it is about one and one-quarter gallons. The vapor from the skin contains organic matter and carbonic acid.

It is this organic matter found in buildings which holds such an important place in the hygiene of air. We have previously mentioned that it has been condensed and collected from the air; it may also be drawn through distilled water by means of an aspirator, and its presence detected on analysis. Angus Smith found that it condensed from a crowded room. If organic matter derived from the skin and lungs of human beings possesses such objectionable properties, what must the organic matter from the habitations of animals possess, when we consider that not only are the skin and lungs acting but that we have deposited in the place where they live the discharges from the bowels and kidneys?

When organic matter is produced, it rapidly adheres to the walls, woodwork, etc., and there, parting with its water, it becomes fixed, forming a greasy coating. This is the reason why the peculiar penetrating odor in badly ventilated stables is so difficult to remove, even with free perflation of air; it hangs to woodwork, walls and ceiling, and is readily experienced on entering a building of this description.

This organic substance, owing to the moisture in the air, is constantly undergoing change, giving out carbonic acid, ammonia and sulphuretted hydrogen. From observations made by Dr. de Chaumont and others, it has been shown that *the organic matter in the air of buildings is in proportion to the carbonic acid of respiration.* This is a most important point, for it affords us a ready index to the purity of the air, by determining the amount of carbonic acid present in it. It must be distinctly repeated, as we shall have later on again to note, that it is not the actual presence of a large amount of carbonic acid in the air which is to be dreaded, but the certain indication which this affords of the large amount of organic matter which is present. This brings us to a consideration of the carbonic acid present in the air as the result of respiration.

In a stable where ridge ventilation or an outlet in the roof exists, the upper stratum of air is the purest; the stratum next the ground is very impure, though, owing to the presence of ammonia, this is not apparent. In collecting, therefore, stable air for analytical purposes, it should never be taken nearer than six feet from the ground. In stables where no outlet exists in the roof, the upper stratum of air is the most impure. The amount of carbonic acid in different parts of the same stable is not the same.

I may say that a difference of two parts in ten thousand in a room, over the normal, is unpleasant to most of us; whilst the presence of five parts per ten thousand of carbonic acid in the air of a room, above the normal, renders the place extremely offensive and oppressive to the senses.

Ammonia is present in traces in the air of towns, but in air vitiated by respiration it may be found in large amounts. The ammonia itself is not injurious, but, as Dr. Smith expresses it, "it has very bad relations, and keeps bad company;" in other words, it is the product of organic matter, and is regarded as another index of impurity.

The following table will show the constitution of the air in the twenty-five barns examined: —

NUMBER.	Carbonic Acid in 10,000 Parts Air.	Condition of Air.	Bacteria found in Ten Litres Air.
	Parts.		
1, ...	8	Fair, . .	350
2, ...	10	Bad, . .	–
3, ...	8	Fair, . .	160
4, ...	12	Bad, . .	500
5, ...	9	Bad, . .	230
6, ...	6.5	Good, . .	270
7, ...	12	Bad, . .	170
8, ...	10	Bad, . .	1,130
9, ...	7.5	Fair, . .	–
10, ...	8	Fair, . .	400
11, ...	8	Fair, . .	170
12, ...	9	Bad, . .	350
13, ...	11	Bad, . .	490
14, ...	14	Very bad, .	420
1, ...	12	Bad, . .	570
2, ...	7.5	Fair, . .	140
3, ...	7	Fair, . .	800
4, ...	6	Good, . .	660
5, ...	9	Bad, . .	400
6, ...	8	Fair, . .	450
7, ...	7	Fair, . .	250
8, ...	7	Fair, . .	750
9, ...	7	Fair, . .	500
10, ...	6	Good, . .	200
11, ...	7	Fair, . .	400

Average number of bacteria of barns with air good, . . .	376
Average number of bacteria of barns with air fair, . . .	397
Average number of bacteria of barns with air bad, . . .	473

Emanations from manure pits are commonly believed, even by well-informed persons, to be *healthy.* The idea is a very absurd one, and probably arises from the fact that outbreaks of disease are not traceable to this cause, as others more potent, and nearer to the animal, are acting at the same time. Manure, when placed in the pit, undergoes decomposition; large quantities of ammoniacal gases, organic vapors and carbonic acid are formed; but, owing to the nature of the mass, these substances can only escape in a partial degree, and are rapidly diluted with air as they pass out, so that the odor of the substance is faint. But let the surface be removed, and allow the hogs to work it over, and then the noxious, penetrating, poisonous products of animal and vegetable decomposition come out with full intensity. Still, many of our cattle are confined over just such places.

We have before seen the enormous amount of impurity conveyed into the air by horses and cattle in health; and have pointed out that, owing to the fact that animals have to live, sleep, eat, drink, defæcate and urinate all in one place and under one roof, the organic emanations are particularly foul.

To make matters worse, we have a strong and popular prejudice against fresh air, — a prejudice not perhaps so marked as in the days when every crevice, including the key-hole, was carefully stuffed, but still sufficiently strong to form a most formidable barrier to the progress of veterinary hygiene. On entering stables of this description, a penetrating odor, unmistakably of organic matter, is met with; a hot, damp, muggy feeling, which is insupportable, accompanied by pungent ammoniated vapors, which irritate the conjunctiva, — the mucous membrane which lines the inner surface of the eyelids.

The CHAIRMAN. I find the following printed on our programme: "The lectures will be followed by discussion, in which all persons present are invited to engage."

Mr. A. PRATT (of North Middleborough). I want to ask the doctor to go a little further in regard to those three stables which were found to be in good condition. If I understood rightly, out of the twenty-five examined the air in three was found to be pure and good; and I would like to know the system of ventilation, and also what was the condition of the cattle as to disease in these stables. I believe that a great deal of this disease in cattle has been in consequence of impure air and poor ventilation in stables.

Dr. Osgood. None of the stables that I speak of had had the whole herd examined. The examiner went about and took barns indiscriminately, not trying to pick out the best or the poorest, but taking those barns that were convenient to the railroad station, where he could reach them early in the morning. There may have been a quarantined animal removed from some of them, but none of the herds had had a systematic examination. Two of the barns were without cellars, one story, and built on the plan that barns are built to-day, with ventilation in the roof.

Mr. Pratt. What was the number of animals?

Dr. Osgood. Forty, sixteen, forty, twenty and fifteen.

Mr. Pratt. How much pure air should a medium-sized creature have?

Dr. Osgood. One thousand cubic feet, with a change of air two or three times a day. The gentleman states that he believes the majority of the cases of tuberculosis are due to impure air. Now, it is utterly impossible to have tuberculosis except you receive the germ from some other tuberculous animal or tuberculous being of some kind. To illustrate the case, I will give you two barns in Falmouth, built at the same time, the same system, built some nine years ago. They each had thoroughbred Guernsey cattle. In one case the cattle had all been bred on the farm, in the other they had imported many animals. If they went to a fair and saw a remarkably fine animal, they bought it and brought it home. I examined these two herds a year ago or more. In one herd (thirty-four animals) there was not a case of tuberculosis, in the other herd every animal was diseased. In one case they had bred the animals on the farm for nine years without importing an animal, in the other they kept introducing fancy animals. Bear in mind, — these were both thoroughbred Guernsey herds. The buildings were exact duplicates, ventilation, size, everything exactly the same, — all the conditions alike, with the exception that one had introduced animals from without and the other had not. There was only a stone wall between the two farms.

QUESTION. I would like to ask if you can explain why all the animals which have been purchased were diseased, while those raised were not diseased? There might have been some diseased animals purchased, but why all?

Dr. OSGOOD. I do not fancy that all that were purchased were diseased, but I fancy that a sufficient number of diseased animals were purchased to affect the whole herd. Close association with one diseased animal is often sufficient to affect the whole herd.

The SECRETARY. A gentleman day before yesterday (he is not here now), in the discussion on the report of the secretary, made the remark that he had requested the commission some three months ago to examine some of his cattle, and he had not been able to get it done. I would like to ask the doctor if he can and will explain that, and whether it is true, or not.

Dr. OSGOOD. I cannot understand that being a fact, because I think we have never been over six weeks behind.

The SECRETARY. It was Mr. Blair of Blandford.

Dr. OSGOOD. I never heard of him. It has never come to my knowledge.

Mr. MUNSON (of Huntington). I think there have been applications in from Huntington two or three months. We sent our blanks in, and the next time the inspector came he said they had been received, but he had received word from the office that they were not going to inspect any more.

Mr. BARTON (of Dalton). I was in the commissioners' office about two weeks ago, and saw an application that had come in without any signature. Possibly some of the applications have been made in that way.

Dr. OSGOOD. There are quite a number of cases in the vicinity of Huntington that we have been working up just as rapidly as we could, but have made it the policy, where a large number applied in a town, to wait until we could complete the whole town at the same time. I think Mr.

Dennen is going to Huntington this week. Your statement is correct as to the number of weeks those applications have been in.

Mr. HEATH (of Stockbridge). My attention was called to the liver of a turkey the day before Thanksgiving, and it looked to me like a case of tuberculosis. Do you find the disease in fowls?

Dr. OSGOOD. It is very common in poultry, although it is not exactly the same species as we find in cattle and in human beings. It is not transmissible from poultry to cattle.

The SECRETARY. Is the human tuberculosis transmissible to cattle?

Dr. OSGOOD. Under certain conditions; yes.

Mr. C. B. LYMAN (of Southampton). Is tuberculosis common in sheep?

Dr. OSGOOD. I know of no authentic report of its being found in sheep.

Mr. ——. I had a sheep condemned by our local inspector, which I butchered six weeks ago. A little piece of one lung had two or three little cells of some kind of matter in them. I was ordered to bury it.

Dr. OSGOOD. What was it condemned for?

Mr. ——. Tuberculosis.

The SECRETARY. Do you consider yourselves responsible for all the mistakes of the inspectors?

Dr. OSGOOD. I might say that we are in no way responsible for the inspectors. They are not appointed by the Cattle Commission. Their duties are simply to report what they find in the way of diseased cattle to us.

The CHAIRMAN. Do you have the power of removal?

Dr. OSGOOD. We have the power of removal, — a power that we have never exercised, however. If they do not perform their duties, the commission has power to remove them and appoint some one in their place. A mistake would not give us that power.

The CHAIRMAN. Suppose you should remove an inspector, — would you have the power to dictate who would take his place?

Dr. OSGOOD. Yes.

Mr. A. BRADLEY (of Lee). The Cattle Commission are sent to a neighborhood, and they take one, two or three herds and rid them of all disease. There is a herd across the street that is badly diseased. What are the liabilities of these cattle which have been freed from the disease taking the disease from the cattle across the street?

Dr. Osgood. Exposure to direct rays of sunlight is almost sure death to the germs. The danger of the transmission of the disease from one side of the street to the other through the medium of the atmosphere I do not think is worth considering. Probably the common cause of the spread of the disease is from the dry bacilli of the disease being inhaled by other animals.

Mr. Bradley. It is not transmissible through the moisture of the discharges?

Dr. Osgood. It can be transmitted by the moist discharge, but by the law of gravitation it falls to the ground, and is not likely to rise until it becomes dry. It is not so likely to be transmitted in that way as it is to be inhaled in the dry form.

Mr. Bradley. In the spring of the year, when our cattle are in the streets, being driven to and from pasture, are they liable to take the disease from other cattle, which are driven over the same road, that are diseased?

Dr. Osgood. I think the chances would be small. Fifteen minutes of sunlight is usually sufficient to destroy the bacilli in the discharge.

Mr. Pratt. How long after applying tuberculin to a herd, and finding it perfectly sound, do you wait before applying it the second time?

Dr. Osgood. One illustration: we tested, eighteen months ago, a herd consisting of seventy-five animals; thirty-five of them were found to be diseased, and were killed. A month ago, seventeen months after, I retested the herd, and not a reaction. I can cite to you four or five stables that have gone that length of time without any trace of the disease. I went through the herd, and every animal that reacted I killed. Any animal that showed the least evidence of a deviation of temperature I put one side. All those that there was a particle of doubt about, those that we could not determine, we destroyed. Those that we were certain about, we put into the herd. There was a boiler in the barn. They attached a pipe to the boiler and went into the stable with live steam until the planks warped right out of place. After that we whitewashed it with a solution of bichloride of mercury. Nothing has been done since, with the exception of keeping it ordinarily clean, and the disease has not appeared since.

Mr. Pratt. How long since you made the last test?

Dr. Osgood. About three weeks.

Question. How much variation of temperature do you allow in order to satisfy you that an animal is diseased?

Dr. Osgood. That would depend on the physical condition. If an animal in apparently poor physical condition had a variation in temperature of one degree, we would condemn it. If it were a fine-looking animal, and had every appearance of health, we would put it one side for a future examination.

Question. Does the difference in temperature indicate the extent of the disease?

Dr. Osgood. No; unfortunately, it does not. In the case of infection in an animal in the best physical condition, we get the highest reaction. When we get a reaction running up to one hundred and seven, we almost always look for very slight lesions when we kill the animal. In the most advanced cases we get the least reaction. A deviation of one degree would, perhaps, be satisfactory.

Question. How many hours after the injection of tuberculin do you wait?

Dr. Osgood. We make an inoculation at night, and ten hours after inoculation we take the temperature; then every two hours up to the twentieth hour, provided there has been no reaction before. If it has been completed before that time, we do not continue to take the temperature. If it is negative, we continue up to the twentieth hour, because we may get a reaction at the eighteenth or twentieth hour.

Mr. ——. I would like to have you give your opinion in regard to this: there is a herd, for instance, that is diseased, but not what we would call badly so; that herd is scattering its product all over the country, in butter, milk, etc. Do you think there is danger to the consumers of the products?

Dr. OSGOOD. We look upon the danger as being certain where the udder is diseased, and possibly so in other cases.

Professor BROOKS (of Amherst). Is it safe for a farmer to buy an animal on the tuberculin test, when it has passed the test successfully, of course, out of a herd where the disease exists? In other words, I had this thought in mind: might that animal very recently have taken the germs of disease into her system, and not yet got such a foothold as to give any reaction, but still do so later?

Dr. OSGOOD. I believe that that very case would give you the highest reaction you could get, even before the lesion had become sufficiently developed to be recognized by the naked eye.

Professor BROOKS. Perhaps it would very seldom be found; but suppose there was no lesion at all, but the germ had just passed into the respiratory organs?

Dr. OSGOOD. There has just been an important case in Germany, — just such a case as you present. The animal gave a reaction to tuberculin, — a marked, high reaction. An autopsy was made, and no lesion was found. The owner immediately brought suit. Parts of the bowels were taken to a laboratory in Berlin, where they were examined, and found to be all alive with bacilli; no lesion was found even with the microscope. The bacilli had just gained entrance to the body.

QUESTION. Is it entirely safe to buy an animal on the tuberculin test?

Dr. OSGOOD. I do not think there is any danger in buying an animal from a tuberculous herd, provided you do not introduce her into a diseased herd, and provided she does not show any evidence of tuberculosis.

Mr. BULL. Suppose the germs of disease have not even gained entrance into the body, — may they not be in the hair?

Dr. OSGOOD. You can avoid that by giving her a good washing.

Mr. PRATT. Have you any knowledge that tuberculin can have any injurious effect on cows?

Dr. OSGOOD. We have made some thirty thousand tests. I have yet to know of the first instance in which a healthy animal has been so injured. The opinion of all the governments of the world is that tuberculin has no injurious effect upon animals free from tuberculosis. The opinion seems to be uniform throughout the civilized world. That is the conclusion that is becoming recognized as a fact. We have never had any reason to believe that it could have any injurious effect. Suppose an animal is suffering from bowel trouble of some kind, — it becomes necessary to give it an injection of morphine; our syringe is not absolutely clean; we allow a bubble of air to enter the syringe, and just so sure as we inject it, it causes an abscess. If it had been tuberculin, it would have been attributed to tuberculin. Again, take any animal with hair on the body, — if we puncture the bowels and drive the trocar and carry with it a single hair, the result is an abscess. Just the same in introducing our syringe with the test of tuberculin. If we happen to grind off a piece of hair or dirt from the skin, the result is an abscess. Undoubtedly abscesses have occurred as a result of dirt or foreign bodies of any kind being introduced under the skin, or a bubble of air. Other than that, I have never heard any complaint of tuberculin.

Mr. NEWHALL. If a healthy animal were put into a herd where there were germs, how soon might that animal take the disease and show the effects of it?

Dr. OSGOOD. That will depend entirely on the condition of the animal and the stage of the disease in which the other animals were.

I will give a few figures of the work under the law of 1895 since June 5, when the new law went into effect. We have examined, by voluntary request of the owners, 3,325 animals. Those were herds where the owners had no particular reason to suspect that the disease was present, but, notwithstanding that fact, an examination of the herds showed 26 per cent of the cattle in them to be diseased with tuberculosis; 881 were condemned, and found on autopsy to be diseased. Of 1,639 animals that had been quarantined by local inspectors since June 5, 802 were condemned, nearly 50 per cent. The average price paid for cattle, of which we have condemned 1,732 since June 5, was $35 a head, making $60,620 that has been paid back directly into the farmers' hands. In order to examine these animals and pay all the expenses of the commission, everything, it has cost $16,100, and $60,620 has gone back to the farmer. The expenses of the commission, all its agents, every expense of every kind, office rent and all, make about 20 cents on the dollar, and 80 cents go back to the farmer. It was stated in a newspaper that 59 per cent of the money spent under the law of 1895 went for expenses of the commission. I openly deny that statement, right here. Under the law of 1895 $91,876 was spent. They made some fun of the $35,000 appropriation, but, if you remember, early in the year there was $50,000 added for immediate use. That would have made the appropriation $85,000. At the time the new law came into effect with the $100,000 appropriation, the inspectors had some four or five hundred cattle tied up in quarantine which we had to destroy; so that they were quarantined and condemned under the law of 1895, but had to be paid for out of this $100,000, because they were killed after that time. When the commission began operations under the new law, they had $22,000 in their hands left of the appropriation, which appropriation had been heralded to be $50,000, but was really $35,000. They had an appropriation of $50,000 in February, and they had animals enough ready to kill at the time they got the appropriation to consume $19,876 of the $100,000. The actual expense under that law was $91,876, in organizing this whole work, fitting up the laboratories, hospitals, quarantine stations, — inaugurating the whole work, providing books that will last years, and all appliances that are necessary in fitting any work. The total expense of everything under the law of 1894 was $44,376, and there was returned to the farmer for cattle killed $47,500, — that was under half compensation. If it had been worked as it is now, it would have been certainly a third more. I want to dispute that statement, that 59 per cent goes for the expense of the commission, for it is false.

Mr. Bradley. I do not know as it has been stated what per cent of the suspected cattle have been condemned.

Dr. Osgood. I just stated that, of those examined in private herds by voluntary request, about 26 per cent were diseased. Of those examined that had been quarantined by local inspectors, 50 per cent were diseased.

Mr. Bradley. Considering your experience in the matter, can you make an estimate of the per cent of cattle that have been examined?

Dr. Osgood. I think I could, if I took time enough and sat down with my arithmetic.

Mr. Bradley. The reason I asked was because there are those who are against the operations of the Cattle Commission.

Dr. Osgood. I think enough of the farmers have had practical experience to know that there is plenty of the disease, without doubt.

Mr. Tucker. What per cent of the cattle in Massachusetts are diseased to-day?

Dr. Osgood. I do not like to go on record as guessing. We would have to figure by counties. Our work on the Cape showed very conclusively that there is little if any tuberculosis in that region. How far from the sea that condition extends we do not know. If you want to know the per cent in Worcester County, or Hampshire, Franklin or Berkshire County, we could give a pretty good estimate right now, from the records we have in the office.

Dr. Lindsey (of Amherst). There is one point I want to bring out. I notice that under this new law the farmer makes an application to have his cattle tested, and he has his herd tested by the Cattle Commission; and, so far as I am aware, he is not compelled to do anything to cleanse his barns and stables. I think that, where the inspection has been carried out, the Cattle Commission should insist that the farmer should cleanse his stable. It seems to me it is a very important consideration.

Dr. Osgood. I think that is done under the supervision of the commissioner who has in charge the cleaning up of the herds. Before we examine any herd, the owner signs what we call a voluntary request blank, and agrees to observe all sanitary requirements of the Board, and also that he will not introduce another animal into his herd until declared free from the disease by the test. The methods of disinfecting are the free use of live steam wherever we can get it; in every case the scraping of all woodwork, anything that the animal comes in contact with, with a three-cornered tree scraper; wash with boiling water, and then wash over with bichloride of mercury. This is done in cases under supervision of the commission.

Dr. Lindsey. The farmer signs the paper that he will do so. It struck me that the commission should be a little more emphatic, that this should be carried out, for I think the farmer is apt to be very lax after he gets his money for the tuberculous animals, if not looked after.

Mr. Pratt. How long does this agreement extend?

Dr. Osgood. That they will not *again* introduce into their herds an animal until it has been subjected to the tuberculin test.

Mr. French (of Dalton). I would like to ask how many animals have been killed that did not prove to be diseased?

Dr. Osgood. Under the law of 1895, 4 out of 1,732.

Mr. Bradley. How is it proved that they were not diseased?

Dr. Osgood. Lesions were not found.

Mr. French. Do you know of any case where a man has taken it from an animal?

Dr. Osgood. I think I know of a good many cases where the evidence is about as direct as can be.

Mr. French. In what way could it be taken?

Dr. Osgood. Through the milk.

Mr. French. Why is it not necessary to stop the sale of milk when some animals are condemned?

Dr. Osgood. Do you mean in the voluntary request?

Mr. French. Yes, sir.

Dr. Osgood. They are all condemned that are diseased.

Mr. French. Why not stop the use of the milk at the time they are condemned?

Dr. Osgood. It is instantly stopped. If the farmer is dishonest, and sells it, we cannot be there to stop him.

Mr. French. Is it proved that if a cow does not respond to the test of tuberculin she is free from disease?

Dr. Osgood. I believe it is.

Mr. French. I have no prejudice against the commission, but I helped butcher an animal, within ten days, that had been tested and not condemned, and I found a tubercle on the lungs as large as my fist and eight inches long.

Dr. Osgood. Where was this test made?

Mr. French. In the town of Dalton.

Dr. Osgood. Was it made by the cattle commissioner?

Mr. French. Yes, sir.

Dr. Osgood. In what month?

Mr. French. I cannot say.

Dr. Osgood. How do you know it was made by the cattle commissioner, if you do not know in what month it was made? Did you see the cow examined by the commissioner?

Mr. French. No, sir.

Dr. Osgood. How do you know she was tuberculous?

Mr. French. I suppose she was. The whole herd was examined.

Mr. Newhall. How many do you find that could be condemned on a physical examination?

Dr. Osgood. I do not think in the voluntary requests that two per cent of those killed could have been picked out on physical examination. The tuberculosis need not necessarily be in the lungs. It may be in the glands about the throat, it may be in the udder, it may be in any location where the bacillus finds lodging. I have seen a case where the only trace in the body was found inside the eyelid. You may find it in the glands between the muscles or in the bronchial system.

Mr. Newhall. Will they not generally develop a cough before they die?

Dr. Osgood. Not necessarily.

Mr. Lyman. Would there be any danger of injury from using the milk if the disease were located in the eye?

Dr. Osgood. I do not think so, if we could be sure that that was the only location.

The Secretary. Are there not other forms of disease that would look like tuberculosis, which would be something else? Is it not possible that if any one except an expert were to butcher a cow they might find something about her that they might think was tuberculosis, but would be something else?

Dr. Osgood. We have lots of diseases taken for tuberculosis.

Mr. Lyman. There was a creature killed in our place last winter. I think the test was applied, and she was condemned to be killed. She had a very bad cough, and when she was led out to the slaughter house the man said she coughed all the way. After she was butchered her lungs appeared to be perfectly sound. After a diligent search, somewhere near the windpipe a little hard bunch was found. In that case I should judge that the cough proceeded from that, and not from tuberculosis.

Dr. Osgood. It was quite likely tuberculosis.

Adjourned at 3.40 p.m.

REPORT

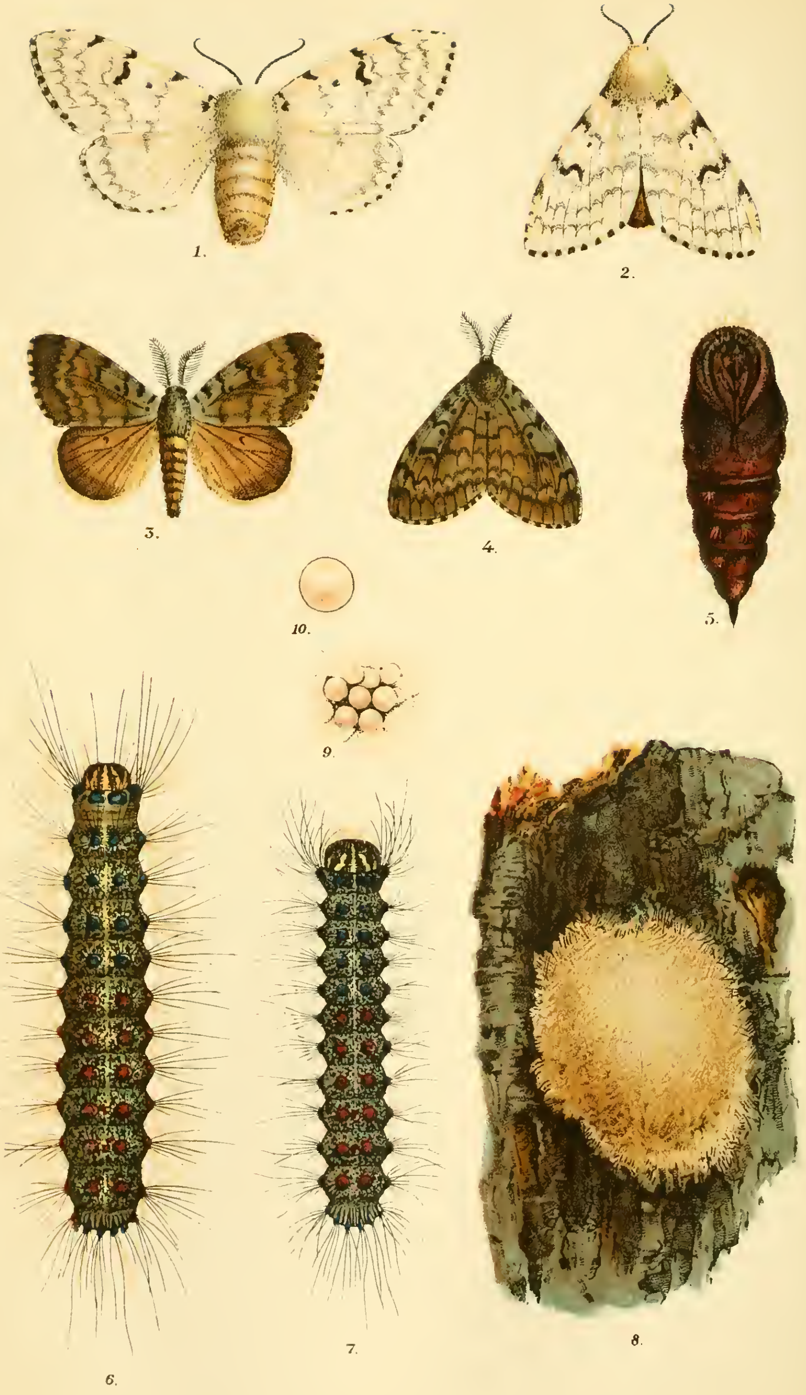
OF THE

STATE BOARD OF AGRICULTURE

ON THE WORK OF

EXTERMINATION OF THE GYPSY MOTH.

PLATE I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Drawn by Joseph Bridgham.

Geo. H. Walker & Co., Boston.

GYPSY MOTH.

An Explanation of Plate I, with a Short Description of the Different Forms of the Gypsy Moth and its Feeding Habits.

THE EGGS.

[Fig. 8, cluster of eggs on bark; Figs. 9 and 10, eggs magnified.]

The eggs are deposited in clusters, averaging about five hundred eggs each, and covered with yellow hairs from the body of the female moth. These egg-clusters are usually found in sheltered places on the bark or in the crevices and cavities of trees, stumps and undergrowth; also on fences and buildings and in the crevices of stone walls and other objects, near the plants or trees on which the insect feeds. The eggs are laid in July, August and September, and hatch after the foliage starts in the late spring or early summer of the ensuing year; therefore the insect passes the fall, winter and early spring in the egg.

THE LARVA OR CATERPILLAR.

[Figs. 6 and 7.]

When first hatched the caterpillars are less than one-fifth of an inch in length. As they grow larger they may be seen in clusters upon the trunks and branches of trees or in the cavities and other hiding-places where the eggs are often found, where they gather in June, July and the first part of August.

THE PUPA.

[Fig. 5.]

The caterpillar when full grown sheds its outer covering and becomes a pupa or chrysalis. This usually occurs in July or August. The pupa may be found in the same situations as the eggs. In Massachusetts the insect usually remains in the pupal state from eight to twelve days, emerging as a moth at the end of that period.

THE MOTH.

[Figs. 1 and 2, female; Figs. 3 and 4, male.]

The female moth usually deposits her eggs very near the abandoned pupa case, and within a few hours after emerging from it. She dies soon after. The male is a rapid flyer. The female does not fly.

HABITS OF THE CATERPILLARS.

The gypsy moth feeds only when in the larval or caterpillar state. In Massachusetts the eggs of the gypsy moth begin hatching about April 20, and the young continue to emerge until the middle of June. The length of larval life varies somewhat according to circumstances, but probably averages ten weeks; therefore the feeding season in this country lasts about four months. When the caterpillars are first hatched from the eggs they are light in color and covered with whitish hairs. In a few hours they assume a dark hue. They usually remain in or near the egg-cluster until they change in color, and should the weather be cold they sometimes remain for several days in a semi-torpid condition upon the egg-cluster. If the temperature is favorable they usually search for food before they are twenty-four hours old. During the first few weeks of their existence they remain most of the time on the leaves, feeding mainly on the under side. Their feeding habits are so uncertain that no rule can be given which will apply to all individuals, but before they are half grown they generally begin to manifest their gregarious instincts. At that time and for the rest of their existence as caterpillars they spend a large part of the day clustered in sheltered situations, and feed principally at night, going up the trees and out on the branches after dark and returning before daybreak. Where they are so abundant that the food supply is insufficient they evince much restlessness, and feed in numbers during all hours of the day and night. They may then be seen hastening to and fro, both up and down the trees. Those which have fed sufficiently are at once replaced by hungry new-comers, and the destruction of the foliage goes on incessantly.

At such times the trunks and lower branches of trees are covered with a moving mass of caterpillars, hurrying throngs are passing and repassing, and nearly every leaf or denuded stem bears up one or more of the feeding insects. The rustling caused by their movements and the continual dropping of excrements is plainly audible. On tall trees the larger caterpillars appear to crawl to the higher limbs, and they seem to prefer to feed well out toward the end of the branches. They do not feed gregariously except when in great numbers; therefore they seldom strip one branch, as do the larvæ of the *Vanessa antiopa*, but scatter throughout the trees, eating a little from each leaf. Early in the season, when they are small and few in numbers, their ravages are scarcely noticed; but as they grow larger and more numerous their inroads on the tree decrease the foliage area night by night, until suddenly all the leaves appear to have been eaten in a single night, and the tree is stripped.

Food Plants.

The gypsy moth is known to destroy the foliage of nearly all native and introduced trees and plants of economic importance. The list of its food plants includes nearly all evergreen and deciduous trees, most bushes, shrubs, vines and vegetables, and it has been seen to eat grass. Wherever the caterpillars become numerous they move slowly, devouring nearly every green leaf and bud as they go. They feed during a much longer season than the canker worm or the tent caterpillar. In the months of June, July and August, 1891, trees which had been stripped early in the season and whose leaves had again put out were again defoliated by these caterpillars and kept bare all summer; therefore not only was all prospect of a fruit harvest destroyed, but many trees were killed by this continual defoliation.

Commonwealth of Massachusetts.

To the Massachusetts State Board of Agriculture.

The committee on the gypsy moth, insects and birds, to whom it was committed "to prevent the spreading and secure the extermination of the *Ocneria dispar* or gypsy moth in this Commonwealth" by the Board of Agriculture, herewith presents the report of expenditures and of work performed during the past year.

The committee has held regular meetings once in two weeks throughout the year, which meetings the director has attended, reporting the progress of the work and receiving directions from the committee. In addition to these regular meetings the members of the committee have attended many special committee meetings, and have spent much time in examination of the territory infested by the gypsy moth and in inspecting the work of the employees. The time thus spent by the members of the committee will aggregate about thirty days each. The committee receive no recompense for time spent in this work. Mr. E. H. Forbush, who has filled the place of director of field work since the work was placed in the hands of the Board of Agriculture, has continued in that position during the past year. Many of the employees of former years have also been retained in their former places, or been promoted to more responsible positions.

The work of inspecting suspected territory and destroying the eggs of the moth was continued through the month of January and until February 6, when the appropriation of 1894 was nearly expended, and the men at work in the field were discharged, leaving the work of this character planned for the winter and early spring of 1895 incomplete. The committee had hoped that the balance remaining of the 1894 appropriation ($20,535.42) would serve to keep this work in progress until the Legislature of 1895 should decide, by the amount of money appropriated, the policy to be pursued for the present year. The Board of Agriculture had recommended the appropriation of $200,000, "if the work is to be carried on under the present statute and the policy of extermination is to be continued." The Legislature appropriated $150,000, three-quarters of the sum recommended, but made no change in the statute. This appropriation did not become available until May 17, 1895, at which date the eggs of the moth had nearly all hatched and the caterpillars were beginning their work. All the experienced men discharged, whom it was possible to re-engage, were at once set at work, but, as has been the case several times in the past under like circumstances, many of them had obtained other employment, and their places were necessarily filled with inexperienced men, who had to learn to do the work required before they could be useful or reliable.

The work of inspection and egg-destroying, stopped in the first week of February, could not be resumed because the caterpillars demanded attention. The territory that should have been cleared of eggs during the late winter and early spring had now to be cared for at increased expense, by spraying and burlapping the trees for the caterpillars. New men were engaged and set at work as fast as they could be examined and instructed, until there were three hundred and sixty-four names on the pay roll. The condition of the forest lands, more than fifty square miles in extent, which has been repeatedly reported as an unknown quantity in the work of extermination, and which the investigation of 1894 showed in part to be very serious, has been more thoroughly looked into, and the fears of the committee have proved well founded. At least three thousand acres of woodland are now known to be infested. Many places, some of them of considerable area, have been found to be infested, some of them to such an extent that the trees were entirely stripped of leaves. In some places discovered during the eating season the caterpillars were found in enormous quantities, covering the trees and bushes and also the ground under them. Every possible effort warranted by the size of the appropriation was made to destroy the caterpillars at the time, except in a few places discovered near the end of the feeding season. In these places they were allowed to transform and lay their eggs, as it was believed that they could be more economically destroyed in the egg form. In one case in Woburn arrangements have been made to cut the wood on the land and burn it, together with the bushes and dry leaves. In other places men have searched the trees and ground for the egg-clusters, destroying them as fast as found by the application of creosote oil. The search of the remaining forest land is being still continued, with the hope of locating all infested places before the green leaves again appear, bringing with them the caterpillars.

The infested territory outside the forest land has been carefully looked after, and that part of it reported as apparently cleared of the moths has been proved in most cases to be free from them. In other places that have been carefully attended to for two or three seasons very few caterpillars have been found. In fact, the condition of the territory other than forest land is better than the committee had expected to be able to report it. A few places outside of forest land have been found considerably infested, notably one in ward 16, Boston, but none in either forest or open land outside the limits of the territory heretofore reported as infested.

The committee has for the past three years recommended the appropriation of all the money that could be economically expended in the work of extermination, and in each year warned the Legislature that any other policy would delay and imperil the final successful result. In 1893 the committee reported plans for the year that would necessitate an appropriation of $165,000. Only $100,000 was appropriated. In 1894 the plans and recommendations called for $165,000. Only $100,000 was appropriated. In 1895 the plans and recommendations called for $200,000. Only $150,000 was appropriated. The result has been what the committee has feared and warned the Legislature to expect, viz., the moth has spread to a large extent in the great forest area within the bounds of the infested territory, and, while the lands other than woodlands are in an encouraging condition, more new places have been found in the woods than have been stamped out in such lands.

In the past three years the committee has been obliged to report that, in addition to the drawback of smaller appropriations than were recommended, the work has suffered severely from delay of action by the Legislature. In 1893 the reduced appropriation did not become available until April 12, and the committee reported that "by reason of the delay at least six weeks of the best working time of the year passed unutilized." In 1894, notwithstanding the fact that the committee reserved about $30,000 for use in the late winter and early spring, the new appropriation did not become available until May 23, and the whole force was discharged two weeks before that date, for want of money to pay their wages. Last year the force was discharged on February 6, because the appropriation was expended, and the work could not be resumed until May 17. The fine weather of February, March, April and half of May passed unutilized.

The committee feel obliged to reiterate what was said in their report last year: "The work has suffered in the past three years almost as much by delay of appropriations as by refusal to appropriate the sums asked for by the committee." In 1895 the delay in making the appropriation was greater than in any one of the three preceding years, and the work suffered in a correspondingly greater degree. It seems to the committee that it is the opposite of economical management to deal with this problem as has been the practice in the past. Either the work should be abandoned, or the appropriations should be ample for the vigorous prosecution of the work, and should be promptly made, so that the money can be used to the utmost advantage. The committee took substantially the same position in the report of 1895, as follows: "The committee believes that the work of extermination should be continued, but is also firmly of the opinion that, if the Legislature is unwilling to appropriate the sum necessary for an aggressive campaign for extermination, the law should be changed so that the Board of Agriculture shall be required to conduct the work only along the line of preventing the spread of the gypsy moth. The committee further believes that, if the Legislature is unwilling to provide sufficient funds for restricting the spread of the gypsy moth and holding it in check, the work should be discontinued entirely."

The committee should not be held responsible for failure if their plans and recommendations are ignored. The final success of extermination has been already gravely imperilled, and the amount necessary for final success largely increased. The committee believes that extermination is still possible if sufficient means are furnished with promptness and regularity. The committee believes that it is of the utmost importance that the gypsy moth should be prevented from spreading into new territory, and desires to record the opinion that the only safe way to prevent the spreading of the insect into new territory is to use every promising means to secure its extermination. In the last annual report of the committee allusion was made to the effort to obtain the assistance of the general government in the work of extermination, and to the favorable reception and patient hearing of a committee of the Board of Agriculture by the agricultural committees of the United States Senate and House of Representatives at Washington. As a result of the hearing an appropriation of $40,000, to aid this State in the work, passed the United States Senate; but, as the final adjournment of the fifty-third Congress was very near at hand, the appropriation failed to pass the House of Representatives.

The committee believes the work to be of national importance; for, if the insect is allowed to spread, it will most certainly invade other States and eventually become a pest in all parts of the country. For this reason it is recommended that means should be immediately taken by the Legislature to bring the matter again to the attention of Congress.

When the committee of this Board appeared before the committees of the fifty-third Congress, it was found that the fact that Massachusetts had undertaken the work of extermination and had expended very large sums of money in it without waiting for the general government insured the attention of the committees and was considered by the committees as an important factor in the case. In another application to Congress for aid the fact that Massachusetts is continuing the work at a great expense will be the best argument that can be presented, as it will prove without question that the people immediately interested are honest in the belief that the work can be carried to a successful conclusion.

The Association of Official Economic Entomologists, which comprises in its membership the most eminent official entomologists of the United States and other American countries, at the annual meeting in Springfield in August last unanimously approved the work of the State of Massachusetts for the extermination of the gypsy moth, and resolved in favor of the work. Several members of the association visited Malden and inspected the work of the committee. They commended the plans and work of the committee in the highest terms. The National Farmers' Congress, which convened at Atlanta, Ga., Oct. 10 to 16, 1895, "*Resolved*, That the Farmers' Congress memorialize the Congress of the United States for aid in protecting the country against the ravages of the gypsy moth, which has so far been held in check by the efforts of a single State." The National Grange, at its annual meeting at Worcester, Mass., November 13 to 21, also passed a similar resolution.

The committee believes that the work could be most economically carried on if an amount sufficient for the work of several years were placed at its disposal, so that, as the work progresses all that should be done might be done at once. In the experience of the past five years it has been often the case that the progress of the work developed an unexpected condition that called for a large outlay immediately; but the amount of money available would not warrant such outlay, and therefore work that should have been done at once has often necessarily been deferred to the next season, to be then performed at largely increased cost. The estimates have always been made for such work as could be planned for in advance, and the recommendations have been for a sum sufficient for such work.

The committee believes that all should be done at once that can be done in a thorough manner. Much of the work can only be done by experienced men, and the amount of such work to be undertaken is dependent upon the number of such men that can be obtained. A careful survey of the territory and consideration of the force obtainable leads to the conclusion that the sum of $200,000 can be economically expended during the ensuing year, and the committee recommends that that sum be promptly appropriated for the work of the year 1896.

Should the appropriation of $200,000 be granted, the committee plans to use it: first, by employing a large force of men, in the early spring, in the work of destroying the eggs.

Wherever this work is thoroughly done there should be no danger of the moths increasing in numbers, as they have in the past year in sections where this work was not done. Such waste lands as are infested would be burned over thoroughly just after the eggs hatched, to secure the extermination of the caterpillars. When this is done the force would be still further increased, and four hundred men would be employed in burlapping and examining the trees in the infested region during the latter part of May, June, July and first half of August. The force would then be reduced by the discharge of the least efficient men, and every effort would be made to examine the entire territory and destroy all the eggs of the moth to be found before another year. During the whole year especial care would need to be exercised to keep all trees and shrubs along railroads, streets and roads clear of caterpillars, to prevent them from spinning down on to teams and passengers, to be by them carried to places not now infested. There are nearly two thousand miles of such streets and roads within the infested towns and cities, requiring the employment of many men and involving a large expenditure. Then the territory round the outside of the infested region must be carefully and continuously watched, to make sure that there can be no infestation of new territory.

To accomplish the work above described the committee estimate that it would require the employment of one hundred and twenty-five experienced men throughout the year (three hundred days) at an average of $2.25 per day, $84,375; three hundred men for temporary employment during five months of spring and summer, at an average of $2 per day, $78,600; sixty-five men (selected from the preceding class) for the last four months of the year, $14,534; making the amount to be paid in wages to superintendents, inspectors and men, $177,509. To this must be added the salaries of director, entomologists and clerks, travelling expenses of the committee, entomologists, director and men, teaming, supplies, tools, insecticides and incidentals, an estimated expense of $23,336, making altogether $200,845, the total estimate of expenses for the year 1896.

The reports of Prof. C. H. Fernald, entomologist to the committee, and E. H. Forbush, director of field work, are printed herewith as a part of this report, and are referred to for details of the work of the past year.

The following is the financial report of the gypsy moth committee of the State Board of Agriculture for 1895: —

Balance on hand Jan. 1, 1895,		$20,535 42
Appropriation for 1895,		150,000 00
		$170,535 42
Expenditures.		
Wm. R. Sessions, expenses,	$16 35	
Augustus Pratt, expenses,	68 54	
E. W. Wood, expenses,	18 40	
John G. Avery, expenses,	121 85	
F. W. Sargent, expenses,	52 60	
S. S. Stetson, expenses,	41 90	
C. H. Fernald, expenses and remuneration,	765 40	
E. H. Forbush, director, salary,	2,400 00	
Book-keeper and clerks in office,	3,141 16	
Travelling expenses of director and men,	2,239 90	
Teaming, livery and board of horses,	2,751 19	
Wages of men,	106,840 23	
Rent of storehouses and office,	440 00	
Supplies, tools and insecticides,	11,915 81	
Balance on hand Jan. 1, 1896,	39,722 09	
		$170,535 42

Four thousand dollars of the $39,722.09 remaining unexpended on January 1 was set aside by the Legislature to be used in printing a report of the history of the gypsy moth in Europe and America, the methods used in destroying the moth and the scientific facts ascertained. This report is now in press. After deducting this $4,000, the balance, $35,722.09, has been reserved for use during the time that must necessarily elapse before the appropriation for 1896 can become available. This course seemed to the committee to be necessary: first, that the experienced and most valuable men might be furnished consecutive employment, and thus be retained in the service of the department ready for the work of the coming year, when another appropriation should become available; second, that the work of cleaning up badly infested localities, begun by cutting brush and wood in the fall and early winter, might be completed by burning over the land in late winter and early spring; third, that the work of searching the remainder of the woodland in the infested territory might be continued, and, if possible, completed before the leaves and caterpillars appear in the coming spring. By this plan the extent of forest infestation, which has heretofore been unknown, may be demonstrated, thus placing before the committee at the beginning of the 1896 campaign the full extent of the work to be done.

E. W. WOOD,
AUGUSTUS PRATT,
F. W. SARGENT,
J. G. AVERY,
S. S. STETSON,
WM. R. SESSIONS,
Committee of the Board of Agriculture in Charge of the Gypsy Moth Work.

FIELD DIRECTOR'S REPORT.

To the Committee on the Gypsy Moth, Insects and Birds.

GENTLEMEN: — The appropriation of 1894 being nearly exhausted in January, the field force was discharged on February 6. No work was done in the field thereafter until early in May, when it was seen that an appropriation would soon become available. The season, being very early, was particularly favorable for the increase and rapid development of the moths, and the necessity for prompt action was appreciated. Those experienced men who were willing to await remuneration for their services until the Legislature should make an appropriation were engaged and put at work early in May. Arrangements were made for the purchase of supplies and the examination of applicants for positions on the force. When the appropriation became available, on May 17, it was too late to accomplish much by the destruction of eggs, as most of them had hatched; therefore, of necessity, the spring work was left undone, three months' time having passed by unimproved which it had been planned to devote to the destruction of eggs, the most important exterminative measure. This enforced neglect necessitated later the killing of the caterpillars which hatched from the eggs in the neglected localities, at an expense ten times greater than the cost of destroying the eggs. Furthermore, it had been planned to burn over some badly infested places where wood and brush had been cut in the previous fall. This burning was to have been done in the early spring when the young caterpillars were hatching, as it is then most effective. This could not be done at that time, however, as the appropriation had not then been made. By the time the force was organized for the work of the season it was too late, as the leaves had started, and the work of burlapping to catch the caterpillars had to be done at once. Therefore much of the work already done in these localities was wasted, as the caterpillars hatched from eggs scattered about on the ground and in the brush, and crawled in all directions seeking food, spreading into adjoining estates before anything could be done to check them.

As far as the clearing of infested localities of the eggs of the moth had progressed in the previous fall, every effort had been made to do thorough work. When this work was interrupted by the snow the plan was to resume it in the spring; but, as no work could be done in the spring, there were many infested localities in which no eggs were destroyed.

The task of burlapping the trees in the infested region was begun as soon as the force was fairly organized, and was finished none too soon, for by the time the necessary number of trees had been banded with burlap the caterpillars were seeking its shelter. An attempt was made to reduce the number of caterpillars as quickly as possible by repeated examinations of the burlaps, thus preventing the moths' reinfesting localities from which they had been exterminated and spreading into localities which had never been infested. As the season advanced, the increase of the moth in some localities where it had not been possible to gather the eggs necessitated the employment of a larger number of men than ever before. The force was increased as rapidly as was compatible with the selection, examination, organization and instruction of the men, until three hundred and sixty-four employees were upon the pay roll. Even with this force, which was as large as could be properly organized, trained and equipped in the short time left for burlapping, it was impossible to care for all the territory and prevent occasional injury to foliage in certain places where, had the appropriation been made in time, it had been planned to examine the trees early in the season and to destroy all eggs found.

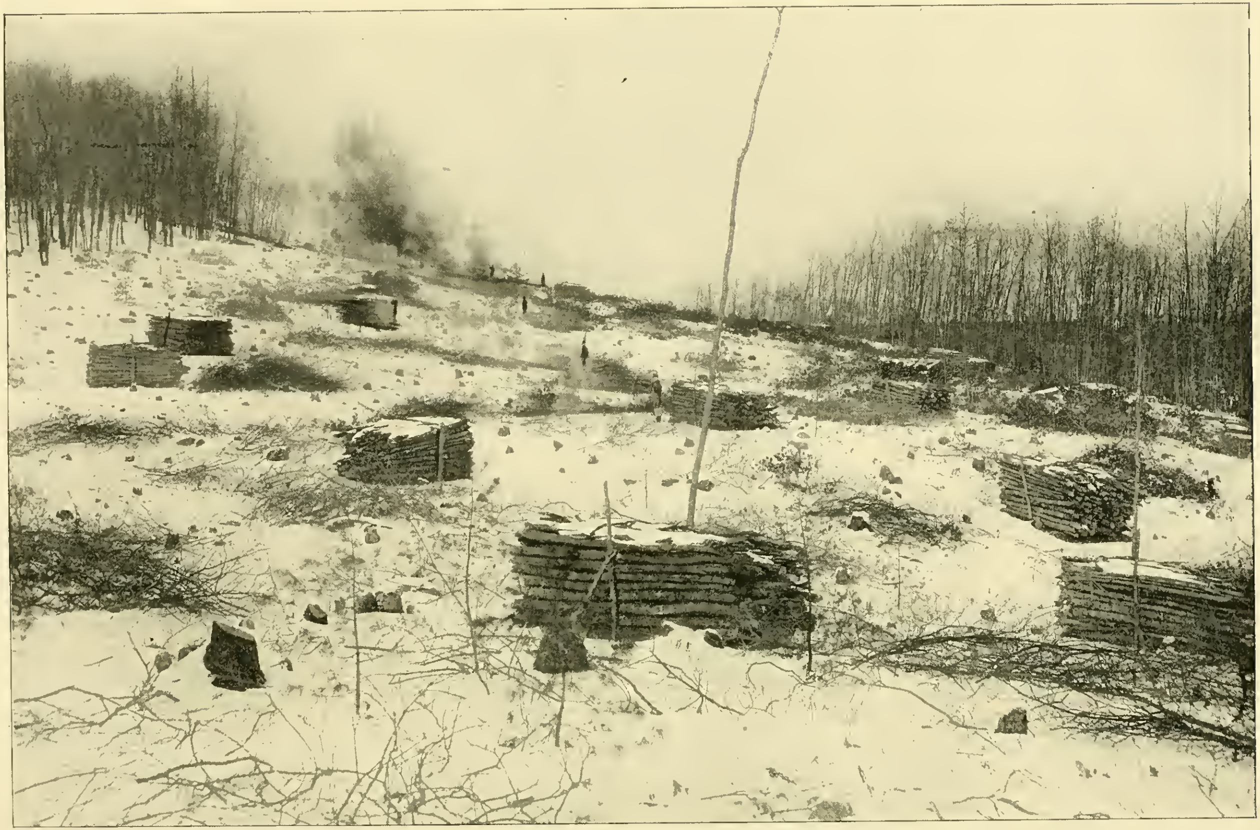
As the caterpillars were nearly all hatched early in the season and their development was exceedingly rapid during May and June, and as, owing to the lateness of the appropriation, very little could be done to check them before the middle of June, their ravages made more showing during 1895 than in any other year since 1891. The moths appeared in ward 16, Boston, on Sargent Street, near where the inspection of the previous winter had been stopped by snow. Many of the trees in a small grove were defoliated before the caterpillars were discovered. Immediate steps were taken to destroy them, and in a short time eighteen bushels of caterpillars and 19,574 pupæ were killed in that locality.

In some localities, where the caterpillars were found upon valuable ornamental shrubs, hedges or fruit trees, the foliage was sprayed with arsenate of lead. Where it was used at a strength of thirty pounds to one hundred and fifty gallons of water, the caterpillars disappeared. Spraying with Paris green and other arsenites has long since been given up as ineffective.

Several outbreaks occurred in the woods within the infested district, to the probable condition of which the attention of the Legislature has been called from year to year by reports of the committee, who have recommended annually for the past three years that appropriations be made large enough to thoroughly inspect these woodlands and check the increase and spread of the moths within them. It has been impossible with the resources provided to protect the cultivated land and the woodland also, as the force of men employed has never been large enough to care for both. It was absolutely necessary that the work should be carefully done in centres of population, in cultivated lands and along highways, so as to prevent a distribution of the moth such as occurred before the State work begun. Before their ravages could be stopped, the gypsy caterpillars had defoliated in June and July several areas of woodland at different localities in Saugus, Medford, Lexington and Woburn, all within the region found infested in 1891. These outbreaks showed that the fears of the committee as to the danger of neglecting the woodland, as expressed in their annual reports to the Legislature, were justified, and were a direct confirmation of the probable results predicted by the committee if the work should be interrupted or stopped.

The appropriation of 1895, being larger than that of the previous year, made possible the beginning of the long-needed thorough inspection of all the woods in the infested territory. As many trained men as could be spared were detailed for this work. It was begun in June, and has been carried on throughout the summer, fall and winter to January 1. While it was impossible with the means at hand to inspect thoroughly all

PLATE 2.



Cutting and burning infested woods.

From a photograph taken in Woburn in December, 1895.

this woodland, a great part of it has been gone over and inspected. It is to be hoped that this work will not be delayed in the spring, and that it may be completed before the eggs hatch. A portion of the appropriation of 1895 has been retained, so that this work and that of killing eggs may be carried on in the winter during favorable weather and continued as soon as the snow melts in the spring. The result of that portion of the inspection which has been completed indicates that the woodland in the infested territory is not as a whole as seriously infested as had been feared. There are, however, three badly infested centres in the woods. One of these, a portion of Middlesex Fells, situated mostly in Medford, is very generally infested. Another, a large tract of woodland in the northern part of Saugus, extends to the borders of the Lynn woods. The third is a tract of woodland and farming land which occupies adjacent parts of Arlington, Lexington and Woburn. These worst infested forest colonies comprise approximately a thousand acres each. Every effort should be made to prevent their extension and to eradicate them now that they are under control; for the expense of exterminating the moths from forest land is much greater than that of eradicating them from cultivated lands. In the principal centres of infestation in all these three localities most of the moths have been destroyed during the present year; but it will be the work of years to completely exterminate the moths from these centres.

In one badly infested locality in Woburn some ten acres of woodland were cut over and the wood burned on the ground (see Plate II.).

The employment of the large force of men, which became necessary during the summer on account of the increase of caterpillars which the lapse of the spring work had permitted, necessitated the expenditure of a large portion of the appropriation; therefore in September one hundred and sixteen men were discharged. One hundred and fifty-two of the most experienced and efficient men were retained. These men continued the work of the inspection of the woods, and this inspection was extended to the confines of the peripheral towns of the infested territory and beyond in some directions. A colony of the moths having been found in the woods in the north-western part of Lexington, one of the towns found infested in 1891, search was made of all the woodland surrounding it and extending into Bedford and Burlington. In Boston the inspection has been extended south through Roxbury and West Roxbury to the Dedham line, the plan being to continue the search as far as Milton and Quincy. No moths have been found in this inspection, which, however, is not yet completed.

Results of the Year's Work.

It has been feared from the first that, unless sufficient appropriations were granted to provide for effective, exterminative work each year over the whole area, some favorable season might give the moths a sudden impetus which would cause them to increase beyond control. During the early spring of 1895 the meteorological and other conditions for such an increase were present. We were obliged to await an appropriation, while the caterpillars were hatching and growing in the mean time under the most auspicious conditions, and beginning to spread over the country. When this hatching and spreading had progressed considerably, the money for the work was appropriated and the task of preventing the spreading and securing the extermination of the moth, which appeared almost hopeless under such circumstances, was again begun. For the first month it seemed as if it might prove an unequal contest, but as the season advanced and the men made their rounds steadily day by day the numbers of the caterpillars gradually decreased, until at the end of the burlapping season there were no known localities except those already referred to in the woods where the moths had made an increase over that of 1894. The work of the fall in inspecting the woods and destroying egg-clusters has still further reduced the numbers of the moths, and revealed the condition of a great tract of woodland within the infested territory. Before the end of the season the moths were well under control, and at the present time there is in the main a considerable improvement in the condition of the infested towns over that of the year 1894. This is especially noticeable in Swampscott, Lynn, Wakefield, Stoneham, Somerville, Cambridge, Arlington, Winchester, Winthrop, Boston and a portion of

Chelsea. The outer row of towns is practically clear of the moth, with the exception of certain wooded sections of Woburn, Lexington and Lynnfield, which have recently been carefully looked over for the first time. The populated portions of the central towns are mostly in better condition in regard to the moth now than they were a year ago. The only localities in which an improvement in the condition has not been made over that of last year are the three infested centres in the woodland hereinbefore named.

If the appropriation now recommended by the committee is granted early in the season, there is every reason to believe that the entire infested territory can be looked over within a year, and that the region occupied by the moth can be still further restricted and a further advance made in the work of extermination.

Number of Men Employed During the Season.

Jan. 1–Jan 5,	133	July 1–July 6,	346
Jan. 7–Jan. 12,	132	July 8–July 13,	346
Jan. 14–Jan. 19,	130	July 15–July 20,	340
Jan. 21–Jan. 26,	137	July 22–July 27,	333
Jan. 28–Feb. 2,	139	July 29–Aug. 3,	329
Feb. 4–Feb. 6,	134	Aug. 5–Aug. 10,	304
Feb. 7–Feb. 9,	16	Aug. 12–Aug. 17,	295
Feb. 11–Feb. 16,	19	Aug. 19–Aug. 24,	286
Feb. 18–Feb. 23,	20	Aug. 26–Aug. 31,	268
Feb. 25–March 2,	25	Sept. 2–Sept. 7,	202
March 4–March 9,	32	Sept. 9–Sept. 14,	184
March 11–March 16,	31	Sept. 16–Sept. 21,	186
March 18–March 23,	31	Sept 23–Sept. 28,	156
March 25–March 30,	32	Sept. 30–Oct. 5,	152
April 1–April 6,	34	Oct. 7–Oct 12,	152
April 8–April 13,	35	Oct 14–Oct. 19,	151
April 15–April 20,	20	Oct. 21–Oct. 26,	151
April 22–April 27,	21	Oct. 28–Nov. 2,	151
April 29–May 4,	131	Nov. 4–Nov. 9,	151
May 6–May 11,	136	Nov. 11–Nov. 16,	152
May 13–May 18,	206	Nov. 18–Nov. 23,	146
May 20–May 25,	224	Nov. 25–Nov. 30,	146
May 27–June 1,	267	Dec. 2–Dec. 7,	143
June 3–June 8,	280	Dec. 9–Dec. 14,	144
June 10–June 15,	301	Dec. 16–Dec. 21,	145
June 17–June 22,	308	Dec. 23–Dec. 28,	121
June 24–June 29,	335	Dec. 30–Dec. 31,	121

The number of men employed as given in the above list includes only the number actually at work each week. The number of employees on the pay roll is usually from ten to twenty more than those actually at work. For instance, from July 1 to July 6 there were three hundred and sixty-four employees on the pay roll, while the number actually at work was only three hundred and forty-six, eighteen persons being either ill, disabled by accidents or absent from other reasons.

Summary of the Year's Work.

By the table given below it will be seen that more than 14,300,000 trees have been inspected, — more than twice as many as were inspected last year. This is accounted for by the greater number of men engaged in the work and the large amount of forest land that has been gone over in the inspection of 1895. The number of different forms of the moth found and destroyed by hand is larger also than in any year since 1891. More than 2,500,000 caterpillars have been destroyed and over 511,000 egg-clusters have been killed. These egg-clusters might have produced 250,000,000 caterpillars next season had they all been allowed to hatch. The great increase in the number of caterpillars and egg-clusters was made possible by the lapse of the spring work, necessitated by the lack of resources, occurring as it did in a season particularly favorable for the moth's increase. At least seventy-five per cent. of these insects were killed in localities which it had been planned to visit, inspect and clear in the spring had the means been provided. A report of the number of the different forms of the moth killed by hand does not always indicate the real increase of the moth or the amount of work accomplished, as ordinarily great numbers of the eggs are killed in the spring by burning and many caterpillars are killed by spraying, and it is evident that no account can be kept of the numbers of eggs or caterpillars destroyed by these methods. This season, however, very little burning or spraying could be done, owing to the lateness of the appropriation; therefore a larger number of men was required to attend to the burlaps, more burlapping was done, and a greater number of caterpillars were killed by hand than in any of the three previous years.

Work Done.

Trees (fruit, shade and forest) : —	
Inspected,	14,374,945
Found to be infested with caterpillars, pupæ, moths or eggs,	76,794
In which cavities have been cemented or covered,	7,146
Burlapped,	931,672
Sprayed,	70
Trimmed,	25,996
Scraped,	2,997
Cut,	43,112
Acres of brushland and woodland cut and burned over,	461¼
Buildings : —	
Inspected,	12,883
Found to be infested,	581
Wooden fences : —	
Inspected,	16,574
Found to be infested,	470
Stone walls : —	
Inspected (rods),	20,783
Found to be infested,	516
Number of each form of the moth destroyed during the year by hand : —	
Caterpillars,	2,164,458
Pupæ,	548,042
Moths,	55,445
Hatched or infertile egg-clusters,	20,569
Unhatched and probably fertile egg-clusters,	511,200

False Alarms.

During the season of 1895 fewer reports of the presence of supposed gypsy moths have been received from towns outside the infested region than in previous years. The measures taken to inform the public in regard to the appearance of the different forms of the moth have resulted in a more general distribution of such knowledge than was formerly the case, and therefore insects bearing no resemblance to the gypsy moth are not as often mistaken for it. As formerly, all cases where any insect supposed to be the gypsy moth has been found have been investigated, and in no case has any evidence of the moth been found outside the region heretofore reported as infested.

The places outside the infested region from which reports of the presence of the gypsy moth have come follow : —

Towns and Cities that have been falsely reported as infested by the Gypsy Moth in 1895.

Massachusetts

Amesbury,
Carlisle,
Concord,
Falmouth,
Ipswich,
Lawrence,
Lowell,
Newton,
Princeton,
Quincy,
Rehoboth,
Templeton.

New Hampshire.

Haverhill,
Lakeport,
Pratt's Station.

Rhode Island.

Pawtucket.

Towns and Cities that are or have been infested.

The following towns and cities have been reported to the committee in previous years as comprising the infested district. The moths have not been found in 1895 in any other towns than those given below, nor have they been this year found in several of these towns. The list comprises, however, what has been alluded to in the report as the infested district.

Arlington,
Belmont,
Beverly,
Boston,
Burlington,
Cambridge,
Chelsea,
Danvers,
Everett,
Lexington,
Lynn,
Lynnfield,
Malden,
Marblehead,
Medford,
Melrose,
Nahant,
Peabody,
Revere,
Reading,
Salem,
Swampscott,
Saugus,
Somerville,
Stoneham,
Wakefield,
Waltham,
Winchester,
Winthrop,
Woburn.

Destructiveness of the Gypsy Moth in Europe.

The report on the gypsy moth provided for by the act of the Legislature of 1894, which is now in press, deals with the history of the gypsy moth in Europe as well as in America.

In order to acquire a comprehensive knowledge of the history of the moth in Europe, its status in times past and present, its ravages, habits, food plants, enemies and the means used there to combat it, all the literature that was obtainable bearing on the subject was examined. A considerable correspondence was carried on with various European and some Asiatic countries. In this way a large amount of information has been obtained, the most important points of which will be presented by Professor Fernald in an abridged form in Part II of that report.

It is a distinct advantage in dealing with the moth here to obtain exact information in regard to its habits and capabilities for injury in Europe and the means used there for its destruction. We are thereby enabled to compare its habits there and here, see what changes they have undergone and gain some idea of how destructive it is likely to be if allowed to spread over this country. A knowledge of its enemies and their effect upon it will also enable us to judge in some degree as to whether we are likely to find effective natural enemies of the moth in this country. The literature on the ravages of the moths in Europe would seem to indicate that they have not been so serious in southern and central Europe within the last twenty-five years as they were during the century preceding, but that they have been very great in Russia and Siberia within the past fifty years. It appears from these reports that the destruction of vegetation by the gypsy moth in Europe has seldom been as complete as it has been in Massachusetts, though its distribution and ravages have had a far wider range. The excess of injury done here appears to be principally due to its extreme multiplication and to the feeding season being usually much longer here than in Europe.

The continuous defoliation of trees results in serious injury or death. The destruction of trees by this insect in Europe is only occasionally recorded; the greatest injury done by the caterpillars to the trees extends over a short portion of the summer; the trees therefore have an opportunity to refoliate themselves. The damage to fruit interests has often been very great, and whole provinces in Russia have raised little or no fruit in certain seasons on account of the ravages of the gypsy moth.

Destructiveness of Introduced Insects.

Even had the gypsy moth never been known as a pest in Europe, it might have become very injurious on its introduction here. It is well known to entomologists in this country that our insect pests which are of European origin have become far more injurious here than in Europe. The wheat midge (*Diplosis tritici*, Kirby.), the cabbage butterfly

(*Pieris rapae*, Linn.), the asparagus beetle (*Crioceris asparagi*, Linn.) and the carpet beetle (*Anthrenus scrophulariae*, Linn.) are examples of the truth of this statement.

The wheat midge has never, throughout its entire European history, extending over a century and a half, approached the destructiveness which it has shown since its advent here. The losses caused by it in New York State alone in 1854, according to estimates made by the secretary of the New York State Agricultural Society, were fifteen million dollars.*

The cabbage butterfly caused for years an annual loss of cabbages about Quebec, Canada, amounting to two hundred and fifty thousand dollars, and in 1870 the loss from this source near New York City was over five hundred thousand dollars.†

The asparagus beetle, which has at times destroyed entire plantations of asparagus upon the sea-board in the vicinity of New York, has been known for centuries in Europe, but has hardly been referred to by writers on economic entomology as an injurious insect. Although common in Russia, a writer in referring to it in 1880, states that it is never known to be obnoxious there.‡

The carpet beetle, commonly known in Massachusetts as the buffalo bug, first recognized in this country in the year 1872, has been known as a common species throughout a large part of Europe for more than a century. While in several portions of the United States it has done incalculable injury, while its ravages on carpets have excited serious alarm in housekeepers, and have threatened to compel a resort to uncarpeted floors, no instance is known of its ever having been detected in feeding upon carpets in Europe, or doing any damage except among dried plants or museum specimens.‡

Mr. L. O. Howard, entomologist to the United States Department of Agriculture, writes in "Insect Life" that "the climate of Europe is much less favorable to the undue multiplication of injurious insects than that of North America. Also, that the actually smaller number of injurious species and the vastly greater familiarity with all phases of the life history of these species by all classes of the people, partly resulting from the older civilization, partly from educational methods and partly from the abundance of elementary and popular literature on questions of this character, the denser population and the resulting vastly smaller holdings in farms, the necessarily greatly diversified crops, the frequent rotation of crops, together with the clean and close cultivation necessitated by the small size of the holdings and the cheaper and more abundant labor, have all resulted in a very different state of affairs regarding the damage which may be done by injurious insects than that existing in this country. When outbreaks of special insects occur in Europe they are handled by commissions." European nations, therefore, can afford to let the insect problem alone to a greater extent than the United States, for the reason that it is of infinitely less importance with them than with us.*

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* Fitch's sixth report (page 12) transactions New York State Agricultural Society, XX, 1860, page 754.

† Report on Rocky Mountain locust, Dr. A. S. Packard, United States Geographical Survey, 1877, page 747.

‡ Hagen in "Canadian Entomologist," X, 1878, page 161.

In France and in some of the German states outbreaks of forest insects are fought by the government forest authorities. In the United States the conditions are quite different. Man is continually disturbing the balance of nature by clearing away the forests, by planting trees upon the prairie, by introducing plants from foreign countries and by destroying animals and birds which feed upon his insect foes. Farms here are large as a rule as compared with those of central Europe, and there is much land untilled and unoccupied where injurious insects can breed unhindered. There are large areas devoted to special crops, which offer the most favorable conditions for the multiplication of insects which feed on those crops.

While the crops of the agriculturist of the United States suffer from the great hordes of indigenous insects, the American farmer also has to battle with many injurious introduced species.

The Losses caused by Insects in the United States.

Probably no country has suffered so much in the same length of time from the ravages of insects as the United States. The Hessian fly (*Cecidomyia destructor*, Say.), imported from

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* "A brief account of the rise and present condition of official economic entomology," L. O. Howard, "Insect Life," Vol. 7, No. 2, page 74.

Europe during the revolutionary war, has almost periodically ravaged the wheat crop in certain sections of the country. In 1885 the injury caused by this insect in Wayne and Ontario counties, New York, was estimated at one hundred thousand dollars.* The cotton worm (*Aletia argillacea*, Hubn.) was very destructive in the south in 1793, 1800, 1804, 1825 and 1826, and has since been very destructive somewhere in the south nearly every year.† The average loss caused by this insect in the cotton States for the fourteen years following the war is estimated at fifteen million dollars a year.‡ The damage in 1873 was estimated at twenty-five million dollars,‡ and the later average annual loss from twenty-five million dollars to fifty million dollars.§

It is only within a few years that the application of insecticides has served to keep the cotton worm in check in a great measure.

Native insects have proved very costly to the agricultural interests. Civilization has given the most favorable opportunities for the multiplication of insects like the chinch bug and the potato beetle (*Doryphora decem.-lineata*, Say.). The loss occasioned by the chinch bug (*Blissus leucopterus*, Say.) in Illinois alone in 1864 is estimated at seventy-three million dollars,‖ and the total loss in this and the adjoining States at one hundred million dollars.¶

The Rocky Mountain locust (*Caloptenus spretus*, Uhler.) has at times ravaged whole States and driven farmers to emigration. Famine has sometimes followed these attacks. The damage in 1874 to 1877 by this insect in the United States is estimated at two hundred million dollars.** The annual damage to agricultural interests in the United States by insects has been variously estimated. In 1868 Mr. B. D. Walsh in the "American Entomologist" estimated it at two hundred million dollars. Since that time it has been variously estimated in different years at from three hundred million dollars to four hundred million dollars.* Mr. James Fletcher, entomologist of the Dominion of Canada, estimates it in 1891 at three hundred and eighty million dollars.† "This sum," he says, "is given up without a murmur and almost without a struggle by the people of the United States;" and he stated, in his report before the committee on agriculture of the Canadian House of Commons, July 4, 1891, that insects destroy one-tenth of the crops of the Dominion of Canada.

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* Fourth annual report injurious and other insects of New York State, by Dr. J. A. Lintner, page 11.

† Dr. A. S. Packard, Jr., report on Rocky Mountain locust, United States Geographical Survey, 1877, page 776.

‡ Fourth report United States Entomological Commission, page 3.

§ Rocky Mountain locust, Packard, page 591.

‖ First annual report of injurious and other insects of New York State, J. A. Lintner, Albany, N. Y., 1882, page 7.

¶ Dr. Shimer's notes on chinch bug, as given by A. S. Packard in report on Rocky Mountain locust, 1877, page 697.

** "Insect Life," vol. 2, page 216.

Most of the foregoing insect pests feed on but few food plants and attack only one class of crops, while the gypsy moth is known to feed on more than three hundred different species of plants, including orchard and forest trees, shrubs, vines and garden vegetables and even some of the grain crops. Its capabilities for destruction, if its increase is allowed, are therefore quite apparent.

History shows that the Commonwealth of Massachusetts has not suffered often or to any such extent by the ravages of insects as have the Western States. It is said in regard to the early history of the colony, that, when a bounty was paid for crows and blackbirds and they were nearly exterminated by the settlers in consequence, the insects increased and destroyed the crops so that the colonists were obliged to send to Pennsylvania and England for hay for their cattle.‡ Occasional invasions of the army worm have occurred. Grasshoppers do some injury to the grass lands and pastures in dry seasons. A large part of the apple crop is given up to the caterpillars, canker worms and codling moths. It is said that the injury to the cranberry crop on Cape Cod by insects has amounted to a million dollars in a single year;§ and Professor Fernald has computed that the application of Paris green to the potato crop to protect it from the ravages of the potato beetle costs the farmers of Massachusetts seventy-six thousand dollars yearly.

These losses are borne as a matter of course, and have seldom attracted general attention. The gypsy moth, however, is capable of destroying the entire fruit crop of the State, and of doing great injury to orchards, gardens, forests and parks. The injury which the gypsy moth would cause to agriculture and horticulture, if allowed to spread over the State, cannot be computed. The expense of holding it in check in our public parks which would have to be borne by the Commonwealth and its various cities, would probably be greater annually than the sum now asked to prevent its spreading and to do all possible towards its extermination.

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* Report United States Department of Agriculture, 1884, page 324.

† "Insect Life," vol. 4, page 13.

‡ Kalm's "Travels in America."

§ Bulletin No. 19, Hatch Experiment Station, May, 1892.

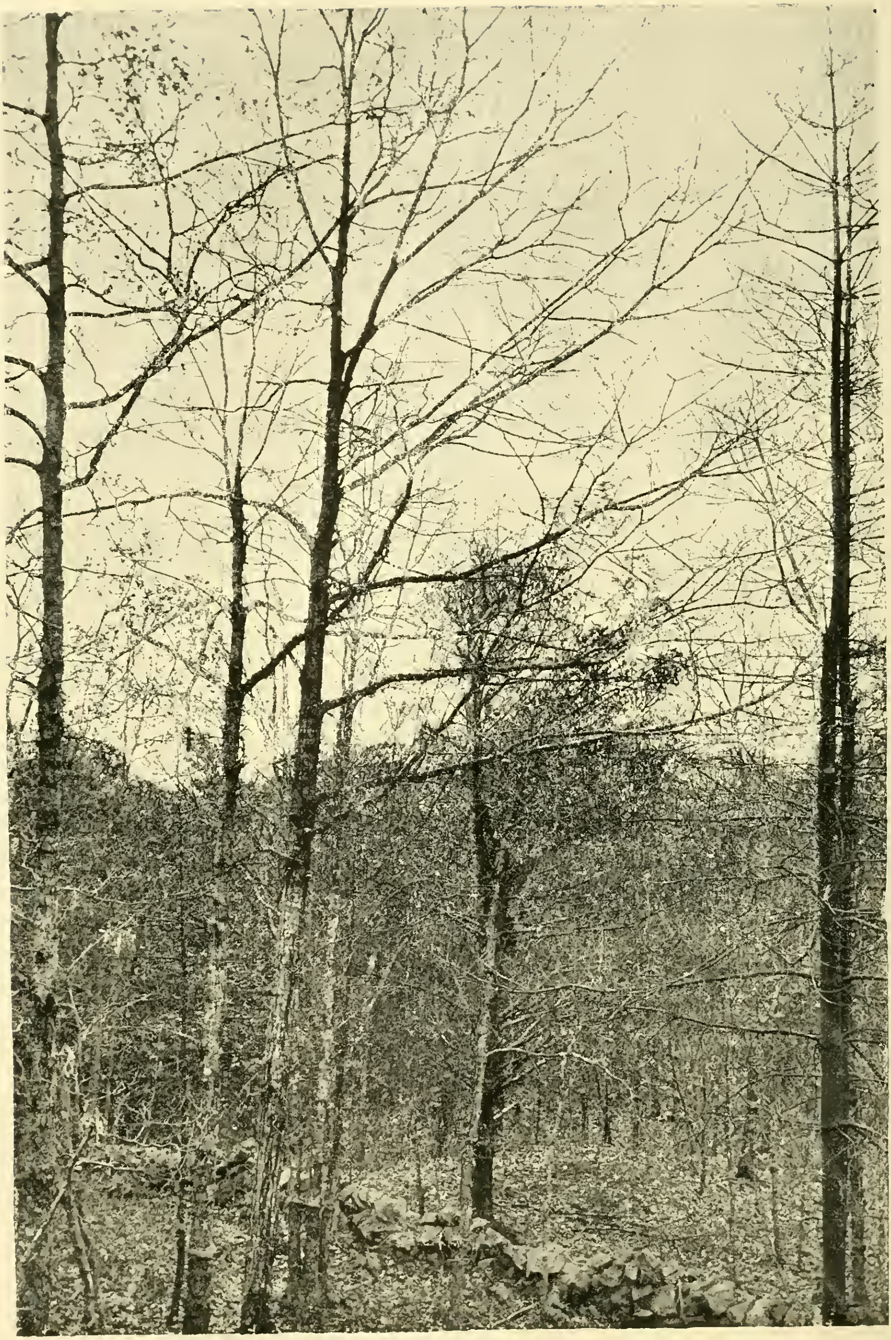
The Destructiveness of the Gypsy Moth in Massachusetts.

Statements from those who have been eye-witnesses of the injury caused by the gypsy moth are given in the appendix which follows the entomologist's report, and will give an idea of its destructiveness, and what would follow should its unchecked increase be permitted.

Respectfully submitted,

E. H. FORBUSH.

PLATE 3.



Oak and pine woods attacked by the gypsy moth.

From a photograph taken in Lexington, Mass., in July, 1895.

Entomologist's Report.

To the Committee on the Gypsy Moth.

Gentlemen: — During the past year I have given what time it was possible to the inspection of the work of destroying the gypsy moth, and to the oversight of the experimental work. The field work has been carried on by Mr. Forbush and his assistants in a most thorough and satisfactory manner, and a vast deal of work has been accomplished.

For several years past the experimental work has been carried on either in the office at Malden or in a room at the storehouse on Commercial Street; but neither of these places was suitable for the experiments that we considered necessary to have performed, and therefore in the early part of the summer a small lot of land in the edge of the forest in the suburbs of Malden was leased, and an insectary was erected on it for experimental purposes. This building has a small greenhouse on the south side and a covered shed on the north. It contains a main laboratory, with tables, closets, etc., a private laboratory and a chemical room on the first floor; while the second floor contains a lodging-room for the employees. The experimental work carried on in this building during the summer of 1895 has proved far more satisfactory than that in the building on Commercial Street, because of the greater conveniences for the work and more healthful conditions for the caterpillars.

To relieve me in part of the constant care and oversight of the experimental work, Mr. A. H. Kirkland, a graduate of the Massachusetts Agricultural College, was appointed assistant entomologist, and has had charge of the insectary and the experiments carried on there, as well as in the field. Mr. Kirkland is admirably fitted for this position, having worked three years in the insectary at Amherst. The committee may be regarded fortunate to secure the services of a man with the natural ability, the scientific attainments, the special training and the enthusiasm in the work that Mr. Kirkland possesses.

At the meeting of the American Association of Economic Entomologists, held in Springfield, Mass., Aug. 28, 1895, I gave an address on the gypsy moth and what the Commonwealth of Massachusetts had done towards its extermination; and in the discussion that followed, participated in by Messrs. Riley, Lintner, Smith, Forbush and Kirkland, Professor Riley closed his remarks as follows: "If I were asked to express an opinion, I should not know what to advise further than what the committee is doing. I think it is doing all that can be done." At the close of the discussion, Prof. L. O. Howard, entomologist to the United States Department of Agriculture, proposed the following resolution, which was unanimously passed: —

Resolved, That it is the sense of this association that the present gypsy moth committee is performing its work in a most intelligent and praiseworthy manner, and that its hands should be upheld by the State authorities.

Several entomologists from other States have visited Malden during the season for the purpose of inspecting the work of destroying the gypsy moth, and have expressed themselves as being greatly pleased with the field work and also the experimental work at the insectary. I have been asked frequently during the past season whether we shall be able to exterminate the gypsy moth, and have been obliged to reply that it depends entirely upon whether the Legislature makes sufficient appropriations; and with that body lies the entire responsibility. The cutting down of the appropriations the past three years and the late time at which these appropriations were made has proved almost disastrous to the work; and if future Legislatures continue this policy, the insect will neither be exterminated nor will it be held in check, but it will escape and spread over the entire Commonwealth and country.

There are those who claim that the State should not appropriate money for the extermination of this insect, but that it should be left to land owners to protect their own property from the ravages of the gypsy moth. This would prove to be the worst possible policy, for the reason that it would be so enormously expensive for land owners, as compared with the expense when carried on by the State.

The value of the taxable property in this State is $2,429,$832,966, and an appropriation of $200,000 is a tax of less than one-twelfth of a mill on a dollar. A man having taxable property to the amount of $5,000 would have to pay a tax of only 41 cents and 6 mills. This beggarly sum of money would make but a small show in the work of clearing gypsy moth caterpillars from an infested $5,000 farm, while in the uninfested parts of the State the land owners would be paying an exceedingly small premium to the State to insure them against the ravages of the gypsy moth. This premium on a $1,000 farm would be 8⅓ cents, and for fifty years it would amount to only $4.16⅔ cents. This protection would extend not only to farmers and owners of forest lands, but also to residents in villages and cities who own lots with trees and shrubs on them, and to vegetation wherever grown within the limits of our Commonwealth.

Respectfully submitted,

C. H. FERNALD.

APPENDIX.

STATEMENTS FROM EYE-WITNESSES OF THE RAVAGES OF THE GYPSY MOTH.

STATEMENT OF MRS. THOMAS F. MAYO, 25 MYRTLE STREET, MEDFORD, MASS.

We had three apple trees, four pear trees, one plum tree and one mountain ash killed by the gypsy moth caterpillars. These trees were stripped of their foliage in the summer of 1887. They began to leaf out again late in the season, but were immediately stripped. The apple trees also put forth a few blossoms at this time. The following year they did not leaf out at all. They all died, and we cut them down. The apple trees were good-sized trees. One was a spice greening, another a Porter and a third an August sweeting. We also cut down a little locust tree which was badly eaten by the caterpillars and the limbs of which died. The caterpillars swarmed in a tall Norway spruce in our back yard. They ate every bit of foliage on this tree, so that we had to cut all the limbs off. Nothing but the pole of this tree remains in our yard to-day. This tree was so full of caterpillars that when I shook a limb with a rake they would fall off in a shower and blacken the ground. There were so many of them that it sounded like pebbles falling. In addition to the trees our currant bushes were stripped by the pest. The caterpillars were worst in 1887, 1888 and 1889. In the summers of those years a good portion of my time was occupied in fighting the pest. The two large elms in front of our house were full of caterpillars, and had not a perfect leaf. In the night-time the noise of the worms eating in the trees sounded like two sticks grating against each other. In the months of July and August I have gone out in the morning and raked up from under the elms a pile of leaves three or four feet high. These leaves had been cut off by the caterpillars, and usually there was a worm on the underside of every leaf. I would pour kerosene over the mass and set it on fire, and the squirming of the caterpillars would cause it to rise up as if it had life of its own. The caterpillars used to cover the basement and clapboards of the house as high as the window sill. They lay in a solid black mass. I would scrape them off into an old dish pan holding about ten quarts.

When it was two-thirds full I poured kerosene over the mass of worms and set them on fire. I used to do this a number of times a day. It was sickening work. I have used, in burning caterpillars, five gallons of kerosene in three days. I have seen my fence black with the small caterpillars when they first hatched out in the spring. I used to kill them on the fence by pouring scalding water on them. The caterpillars used to be very thick in the grass, and there would be one under every fallen leaf. On certain occasions callers have had to wait at the front door until I could sweep the caterpillars off the steps so that they could come in without getting the worms on their clothing. Other yards on the street were in a similar condition to our own, although other neighbors' pear trees escaped serious injury.

The caterpillars were very destructive in the woods behind our house and on the other side of the railroad track. The trees in these woods were principally poplars, maples, oaks and alders. The trees were of a good size. Early in July of one of the years when the caterpillars were most destructive I remember noticing the fine condition of the foliage of these woods. A week or two later the caterpillars had eaten all the leaves of the trees, and the woods looked as if there had been a fire in them. Not realizing what the trouble was, we went to see what had caused the altered appearance of the trees. We found thousands of gypsy moth caterpillars clustered in the crotches of the trees. A small growth of leaves came out on these trees later, only to be eaten off by the pest. The caterpillars used to get on carriages and the clothing of people who went on Myrtle Street.

The bad condition of this section as regards the gypsy moth plague was detrimental to real estate valuations. The caterpillars have now been so much reduced that last year I don't think I saw more than a dozen. The spraying by the Board's employees did much to reduce their numbers, and the gathering of eggs has been even more effective in stamping out the pest. It was well that the State fought the moth, for the people alone could not have handled the work.

(Signed) MRS. LINA D. MAYO.

FEB. 2, 1894.

STATEMENT OF MR. ALMON BLACK, NO. 10 COTTING STREET, MEDFORD.

In 1888 and 1889 the gypsy moth caterpillars were a terrible pest on Cotting Street and in that neighborhood. In a neighbor's yard (Mr. Rugg's) they brushed off of one apple tree at one time fourteen quarts of caterpillars. In another yard two large apple trees were stripped by the caterpillars and died. The way this was brought about was as follows: the caterpillars stripped the trees early in the season, and, as they continued their ravages for nearly the whole summer, the trees had no chance to recover. The next year the trees would leaf out and be stripped again, and so on, until, unable longer to withstand such treatment, they died. The caterpillars ate almost everything, feeding on small fruits and shrubbery as well as the trees. The oaks at the McGowan tannery were stripped clean.

(Signed) ALMON BLACK.

JAN. 25, 1894.

STATEMENT OF MR. ARTHUR W. CROCKFORD, FLORIST, 81 SPRING STREET, MEDFORD.

Four years ago I saw the gypsy moth caterpillars by the thousand on the Sherman lot on Spring Street. I never saw such a sight. Their eggs were as thick on the big willows as spawn in a fish. The trees on the street were also stripped, nothing but the ribs of the leaves being left. In 1889 I had twenty-seven hundred young carnation pinks set out of doors, and the biggest part of them were destroyed by the caterpillars. This was in June. They were eaten off close to the ground. In 1890 the gypsy moth appeared in my green-houses, and the bushes in one rose house were completely eaten up. The foliage seemed all burned. I did not know at first what caused this appearance, but on turning over the leaves I found the young caterpillars on the under sides. They were very small at that time. The house was full of them. The warmth caused them to hatch out early. I destroyed most of them by picking off the leaves and burning them, and also by spraying with an emulsion of whale oil soap, kerosene and ammonia. In this year (1890) the fences in this neighborhood were covered with the gypsy moth caterpillars. We have no trouble now. Since the neighboring brushland has been burnt over by the gypsy moth men the caterpillars have not troubled us.

(Signed) A. W. CROCKFORD.

JAN. 20, 1894.

STATEMENT OF MRS. J. W. FLINN, SEA VIEW AVENUE, MALDEN.

We moved to Myrtle Street, Medford, in 1882, and that year the gypsy moth caterpillars were very troublesome in our yard and in those of our immediate neighbors. At that time they were confined to our part of Myrtle Street, but they soon spread in all directions. The caterpillars were over everything in our yard, and stripped all our fruit trees, taking the apples first and then the pears. There was a beautiful maple on the street in front of the next house, and all the leaves were eaten by the caterpillars. They got from the tree upon the house and blackened the front of it. A young maple which had been set out on the street in front of our house was stripped by them and died. Our vegetable garden was practically ruined by them, peas, beans, corn, etc., being eaten. The garden of our next-door neighbor, Mr. Camp, suffered a like fate. The caterpillars would get into the house in spite of every precaution, and we would even find them upon the clothing hanging in the closets. We destroyed a great many caterpillars by burning, but their numbers did not seem to be lessened in the least. Other neighbors did not fight the caterpillars as we did, and so our efforts were in a measure rendered abortive. I think perhaps that if an organized effort had been made at that time to destroy the caterpillars they might have been stamped out.

We lived on Myrtle Street for four years, and every year had the same plague. A young peach tree died, apparently because it was stripped by the caterpillars. Our raspberry bushes were also stripped of their leaves. We lived later on Lawrence Street, and here also the caterpillars were troublesome. An umbrella bush in the yard was killed by them. The gypsy moth plague hurt property in this section. Our house was advertised for sale, and when people came to look at the property they were apt to inquire why the leaves of the trees in the neighborhood were so badly eaten. When we told them it was the work of the gypsy moth caterpillars they would say that they would not live in such a locality.

(Signed) Mrs. J. W. Flinn.

Jan. 24, 1894.

Statement of Mrs. F. T. Spinney, College Avenue, Medford.

I lived on Cross Street in 1889. In June of that year I was out of town for three days. When I went away the trees in our yard were in splendid condition, and there was no sign of insect devastation upon them. When I returned there was scarcely a leaf upon the trees. The gypsy moth caterpillars were over everything. I used to burn them in the trees with torches. They were so numerous that when they clustered on the trunks they would lap over each other. A neighbor gathered in one day in my yard a peck of caterpillars and poured kerosene over them and set the mass on fire, but many nevertheless walked away from the burning mass. I used to scoop them off the sides of the house and the tree trunks with a dust-pan. We killed them on the fences with boiling water. Their eating in the trees sounded just like a breeze. Many got into the house, and we could not open the windows. I found them in the kitchen and in the bedrooms. I used to find them in the beds when I turned down the blankets.

(Signed) MRS. F. T. SPINNEY.

JAN. 25, 1894.

STATEMENT OF J. C. MILLER, JR., NO. 3 LAURIAT PLACE, MEDFORD.

I moved to Lauriat Place in the late summer of 1889. I noticed an apple tree in Postmaster Spinney's yard completely stripped by a strange caterpillar. Some people called these caterpillars army worms, but they were in reality gypsy moth caterpillars. Only the main ribs of the leaves on Mr. Spinney's trees remained, and sometimes these fell off. The tree appeared almost as it would have in winter. It was a terrible sight. The caterpillars seemed to do their work much more thoroughly than the canker worms. At this time they were crossing from Mr. Spinney's by multitudes into yards on the other side of the street. It seemed but a few hours after they left Mr. Spinney's before they were all through my trees. They came literally in droves, and seemed to have a method in their movements. They were pretty plentiful in the trees in my yard, but I put on printers' ink and got a fair crop of apples, it being late in the summer before they struck into the yard. Nevertheless, their ravages seemed to have an unfavorable effect on the crop as regards the condition of the fruit. The big caterpillars were strong enough to crawl through the fresh ink on the bands around the trunks. The next year (1890) all the orchards in this section were completely ravaged, and there was no fruit. The caterpillars simply swarmed. I destroyed thousands of them by burning them with rags soaked in kerosene. I spent many hours in destroying them, but without making any perceptible difference in their numbers. They were over everything, and even got into the cellars. Some of my apple trees overhang my shop. In the evening when the caterpillars are liveliest the noise of their droppings falling on the shingles sounded like a steady shower. The gutter was brim full and running over with the droppings. In the last year we have had practically no trouble from the caterpillars. . . .

The gypsy moth caterpillar is certainly a menace to the country. It is worse than the canker worm, because individual action will destroy the latter but will not succeed with the former.

(Signed) J. C. MILLER, Jr.

JAN. 23, 1894.

The foregoing statements are all from people who witnessed the earlier outbreaks of the gypsy moth in Medford. The following statements are from residents of Boston who have seen the ravages of the moth there in 1895: —

STATEMENT OF MR. WM. TYNER, 39 SARGENT STREET, DORCHESTER, BOSTON.

Early in June of this year I discovered that a tree in my oak grove was covered clear to the top with large hairy caterpillars. Underneath a squirrel house in another tree there was a great mass of these caterpillars, which resembled a swarm of bees. My son turned the hose on them and knocked them off, and they fell to the ground in a great lump. I could not imagine what these caterpillars were, as I had previously burned all the tent caterpillars on my ground. Upon investigation I found that the trees at one end of the grove were being stripped by these unknown caterpillars, which were later ascertained to be those of the gypsy moth.

I never saw anything like the sight presented by these caterpillars in the succeeding days, before the employees of the Board of Agriculture arrived and began exterminating them. They were all over the trees, collecting in bunches under the branches and wherever there was a knot or other projection. Some were crawling up the trunks and others down, but in addition there was always a collection at the foot of the tree. You could not go into the grove without getting caterpillars on your person. Their droppings fell so thickly that a lot collected in the brim of my Panama hat one day as I passed through the grove. At night-time you could hear very plainly the steady falling of the droppings on the leaves, also the noise made by the caterpillars eating the leaves. It sounded like a shower.

These caterpillars would strip an oak tree down to the twigs in three days' time. We set out a rose bush one night behind the house, and in the morning the caterpillars had left nothing of it but the stem and twigs. We killed a good many of them, but as fast as we destroyed them others would take their places. They are very tenacious of life. We scalded some with hot water. They would crawl under the eaves and the steps and window sills, and into the house if possible. My nephew found one in his bed.

If the caterpillars had been allowed to go on one week longer, there would not have been a green thing left. They had begun to scatter, and were crawling through the grass on the lawn and across the street on the day when the gypsy moth men arrived. The employees killed them in great numbers and burned many bushels in all.

(Signed) WILLIAM TYNER.

DEC. 31, 1895.

STATEMENT OF MR. JOHN A. BRUEN, NO. 27 SARGENT STREET, DORCHESTER, BOSTON.

The gypsy moth caterpillars stripped the five trees in our yard last summer, not leaving a leaf upon them. It was about the first of June that we first noticed the great number of caterpillars about the place. They were so numerous about the back balcony of the house that we were unable during a good portion of the summer to sit there.

I used to wash the caterpillars off the trees and house by playing upon them with the hose, but they would immediately crawl up to their former position again. In a crotch in the oak tree growing at the corner of the balcony there was a mass of caterpillars as big as my hat. I turned the hose on them and knocked them off in lumps as big as your fist, but the caterpillars crawled up the tree again with amazing rapidity.

The caterpillars made considerable noise at night while eating; it sounded like the clipping of scissors. In the morning the bits of leaves, which the caterpillars had eaten off, made a green carpet on the board walk. After stripping our trees and those on estates adjoining, the caterpillars began to crawl across the street. They seemed to be migrating in search of food.

(Signed) JOHN A. BRUEN.

DEC. 31, 1895.

STATEMENT OF MRS. T. J. LANE, NO. 29 SARGENT STREET, DORCHESTER, BOSTON.

In June, 1895, our place was black with caterpillars, and the yard was strewn with pieces of leaves which fell from the trees where the foliage was being destroyed by the vermin. We did not know that these were the gypsy moth caterpillars until informed by the employees of the Board of Agriculture. The trees in our yard were eaten entirely bare of leaves. The back of the L and the trees overhanging it were practically covered with caterpillars. Under the gutter at the corner of the house they lay in one great, long, black, repulsive mass. They lay thick in the gutter, and we played a strong stream on them from the hose, but it did not seem to affect them any. If we went out beneath the trees, we got caterpillars all over us. Before they got their full growth, they would string down in myriads by fine threads. Even when we went along the walk at the side of the house, with no tree within thirty or forty feet, we would still find them floating in the air by their fine, almost imperceptible threads. When they got larger, the disgusting creatures would crawl into the house.

The shade in the oak grove behind the house was ruined. The leaves on some trees were all eaten, on others they were riddled. At night-time you could hear the caterpillars cracking away in the grove. By "cracking" I mean the noise of their chewing. After the gypsy moth men had been at work a few days the ravages of the moth were stopped.

(Signed) Mrs. T. J. Lane.

Dec. 31, 1895.

FIFTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED

UNDER CHAPTER 412, ACTS OF 1891.

JANUARY 15, 1896.

DAIRY BUREAU — 1895-96.

C. L. HARTSHORN, WORCESTER, *Chairman.*
GEO. L. CLEMENCE, SOUTHBRIDGE.
D. A. HORTON, NORTHAMPTON.

Executive Officer.

W. R. SESSIONS, *Secretary of the State Board of Agriculture.*

Assistant to the Secretary and Acting Executive Officer, appointed by the Governor.

GEO. M. WHITAKER, BOSTON.

REPORT OF THE DAIRY BUREAU.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The membership of the Bureau has been unchanged during the past year, Mr. D. A. Horton having been reappointed by the governor as one of the three members at large of the Board of Agriculture, and as a member of the Dairy Bureau. The assistant to the secretary of the Board of Agriculture in the work of the Dairy Bureau, as provided for by chapter 412 of the Acts of 1891, is the acting executive officer of the Bureau, the secretary of the Board being the executive officer, *ex officio*, by the same statute. The present incumbent was reappointed last September.

During the year the Bureau has employed permanently two agents who have acted as inspectors, to ascertain how the dairy laws are obeyed, to collect samples and to get evidence of violation of the law. These have been J. W. Stockwell and George F. Baldwin. In accordance with our recommendation of last year, our annual appropriation was increased by the Legislature of 1895 from $4,000 to $7,000.

OLEOMARGARINE.

The work of the Bureau in enforcing the laws relative to imitation butter has been statistically as follows: —

Number of inspections of stores and other places of business,	1,901
Number of samples taken,	474
Number of cases in court,	82
Number of convictions,	42

The cases in court were brought for the following violations of the law : —

Serving oleomargarine in restaurants without giving notice,	30
Absence of sign in store,	17
Sales of oleomargarine when butter was called for,	7
Failure to mark exposed contents of opened tub,	7
Sales of yellow oleomargarine,	6
Sales without municipal license,	6
Sales without marked wrapper,	5
Assaults on agents of the Bureau,	3
Delivery from wagon without sign on sides,	1
	82

These violations of the law were all outside of Boston, as, under the provision of the law requiring us to work in harmony with milk inspectors and the Board of Health, we have left the city of Boston, as has been previously reported, to the milk inspector of that city, Dr. Charles E. Harrington, who has performed his work with great faithfulness and ability.

Cases appealed from the district to the superior court have been settled, in every case but one, by the defendant pleading guilty. In that case the inspector had called for cooking butter and been served with oleomargarine, and the jury failed to agree, as the question was raised whether or not "cooking butter" was a separate and distinct article of commerce by itself, and therefore not what is meant by the statute which prohibits the selling of oleomargarine when butter is called for.

The laws regulating the sale of oleomargarine are such that it is possible for a person, in one sale, to violate a number of different statutes. If he sells yellow oleomargarine when butter is called for, does it up in an unmarked wrapper, and has no sign in the store, four laws are violated ; and usually, where a person is trying to sell oleomargarine deceptively, in order to carry out the deception, he will violate more laws than one. But we find that many district court judges dislike to entertain more than one case based on a single transaction. In a few instances we have found judges who were unwilling to entertain more than one case against the same person, even when the violations of the law took place on different days, and when there had been distinct sales. On this account the statistical showing of cases in court is not as large as it otherwise would be.

The work of the Bureau in inspecting stores and other places of business, to see how the laws are complied with, and its growth from year to year, are seen in the following table: —

1893,	382 inspections.
1894,	716 inspections.
1895,	1,901 inspections.

This work has covered all parts of the State, except Boston, and, coupled with the efforts of Dr. Harrington * in Boston, has been so thorough that dealers are, for the most part, complying with the law, which still further reduces our number of court cases; but, when a law is so enforced as to prevent crime, the result is more satisfactory to all thoughtful citizens than is the record of a long list of criminal prosecutions.

Very little oleomargarine is now sold in the State illegally.

The decision of the national supreme court, affirming the constitutionality of the State statute which prohibits the sale of any imitation of yellow butter, has been a severe blow to dealers in imitation dairy goods, and has virtually put an end to the business in this State, so far as open sales are concerned. The number of revenue licenses in Massachusetts when the Bureau was created was 211; the number now is 35. The figures from the Boston Chamber of Commerce show that the receipts of oleomargarine for the year 1895 decreased 151,421 packages, as compared with the year previous. The receipts of butter show an increase of

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* The cases of the Boston milk inspector for the year ending Jan. 31, 1895, were: —

Sale of oleomargarine not properly labelled,	4
Exposing oleomargarine for sale, not being licensed,	5
Sale of oleomargarine, not being registered,	3
Sale of oleomargarine as butter,	4
Sale of oleomargarine without posting placard,	3
Sale of oleomargarine from wagons not properly marked,	2
Serving oleomargarine in restaurants without notifying guests,	32

179,379 tubs, not counting the boxes, and the consumption of butter increased very materially.

Although oleomargarine is a substance of "great food value," "a distinct, independent article," pushed on "the merits of its individuality," we find that what the dealers care for, more than the nutritive elements or number of calories of food value, is the yellow color of butter; and, if they cannot have the article colored in imitation of a product which it is not, their occupation is largely gone. Much yellow oleomargarine, however, still comes into the State from Rhode Island, which has been behind all the other New England States in oleomargarine legislation, and is now the centre of operations for a large business in this State. Several manufacturing companies have located in Rhode Island, among them the Vermont Manufacturing Company and the Woodlawn Dairy Company. These have agents in Massachusetts, who leave with boarding-house proprietors and others in manufacturing cities and towns blank orders which when filled out are sent to Rhode Island. The goods are then forwarded to them by express or freight. Sometimes, doubtless, the legal sale takes place in Massachusetts; but to get evidence of this is difficult, and would require much expense for skilful detective work, and often, then, we might have nothing to show for the money expended. The following are two forms of orders used: —

Swift & Co., 252–262 Canal Street, Providence, R. I.
Please send to Swift's colored butterine, price .
Ship by
And oblige,

189 .
Woodlawn Dairy Co., Pawtucket, R. I.
DEAR SIR: — Please send me by express, C. O. D.: —
Tub butterine, lbs., at cts.
Box prints, lbs., at cts.
and oblige,
Yours truly,

Our agents have in a number of cases watched the receipts of oleomargarine at various railroad depots, followed the goods to the place of consumption, and found that they went chiefly to boarding-houses and fishing schooners. Some oleomargarine goes to hotels and restaurants and some to private families.

Our third and fourth reports called attention to the deceptive style of advertising adopted by many manufacturers of oleomargarine. In the former we reproduced a fac-simile of the trade-mark of one firm, which consisted of a pretty dairymaid, her left arm about a Jersey heifer, and a milk pail in her right hand. The inscription was "Jersey Butterine," and everything about it except the three letters "ine" was suggestive of the dairy.

This wrong has been met by an important order from the internal revenue department at Washington, as follows: —

> No manufacturer of or dealer in oleomargarine will be permitted to use any private trade-mark, label, brand, picture illustration or other advertising or descriptive device upon any print, roll or other mold or design of oleomargarine offered for sale, consumption or use, which in any wise conceals the fact that the product is oleomargarine. This rule applies as well to the wooden or paper package or wrapper of any print, roll or other mold or design of oleomargarine.
>
> Under this regulation it will be seen that the use of any trade-mark, label, brand, picture illustration, or advertising or descriptive device representing a cow, dairy farm, or in any other form indicating the oleomargarine to be a product of the dairy, or calculated to induce the belief that it is such dairy product, is inadmissible.
>
> The use of the word "butterine" is also inadmissible, since section 2 of the act of Aug. 2, 1886, prescribes that "butterine" shall be known and *designated* as "oleomargarine."

The advance of time may have rendered the arguments for legislation regulating the sale of imitation butter less keenly realized than when the laws were enacted, and it may be well to restate that all of this legislation has been rendered necessary because: first, yellow oleomargarine is an imitation article; second, all imitation articles are more or less deceptive, the very word "imitation" signifying misrepresentation; third, the selling of these goods where no restrictions exist is always attended with considerable actual fraud; the dealers oppose all legislation which would require the product to be sold honestly, and, as a rule, deceive the consuming public as far as they can.

It is also worthy of notice that, since the Massachusetts laws were enacted, they have been copied by a number of other States; and this department is frequently requested to furnish copies of our laws to legislative bodies, boards of trade, dairymen's associations, etc., in other States.

Process Butter.

The attention of the Bureau has been brought two or three times during the year to various kinds of "process butter," as it is called. This is butter which has been renovated and reworked by some patent process. Analysis shows that it is pure butter, but that it contains more than the normal amount of moisture. One sample was found to contain: —

	Per Cent.
Butter fat,	78.18
Water,	17.18
Suet,	2.32
Curd and other solids not fat,	2.32
	100.00

This fact, and the varying degrees of moisture reported in butter exhibited at the State fair at Worcester, alluded to later on, bring up again the suggestion whether or not there should be a statute standard for butter; and, while we do not favor making our government paternal beyond proper limits, yet there is a possibility of people being deceived and defrauded in their purchases of even real butter.

Milk Laws.

The Bureau has done more this year in the line of milk inspection than heretofore, having taken and analyzed 158 samples. No cases have been taken into court, as this was our first year of work in this line. A number of warnings, however, were sent to persons whose milk was below standard. A prominent part of our work in this line this season was in inspecting the milk supply at the various beaches in the vicinity of Boston, including restaurants. The milk in most cases was quite satisfactory, being fully up to the standard. In one or two cases where milk of very poor quality was found, the inspector on a second visit got milk of much higher quality, in one case almost cream, showing that the dealer had been careless in mixing the milk, giving some customers cream from the top of the tank, while others got skim-milk from the bottom. In such cases warnings were sent.

Some restaurants refuse to sell milk to a guest; a few have skim-milk signs on their milk tanks; and a few cases have been found where the proprietor of a restaurant posted a sign announcing that he sold pure, unadulterated milk, as it came from the cow, but on account of the State law, in order to save himself from liability to prosecution, he advertised all milk which he sold to be skim-milk.

We give below the averages of the samples of milk taken by this department during the year past, the low showing through July and August being due to a number of samples of low-grade milk taken from restaurants at the beaches, to whom warnings were sent, which resulted in an improvement of the quality.

	No. Samples.	Average.
July,	33	12.48 per cent total solids.
August,	10	12.57 " " "
September,	21	13.08 " " "
October,	20	13.39 " " "
November,	8	13.84 " " "
December,	52	13.09 " " "
December,	14	4.92 " fat.

Dr. Harrington, the milk inspector of Boston for the year ending Jan. 31, 1895, reports 14,203 samples of milk collected for examination. Out of this number, 142 complaints were entered in court and 138 convictions obtained. Of Dr. Harrington's cases in court, 48 were for milk of below 11 per cent total solids; 87 for milk below 12 per cent, but not below 11; 7 cases were for milk ranging from 12 to 12.6 per cent.

Of late there has been an annual agitation before the Legislature for a reduction of the statute standard. On this subject we renew our recommendations of previous years in opposition to any such reduction, which we believe would be an injury to the consuming public and also to the better class of producers. An abundance of evidence can be brought forward to prove that average milk from average cows has 13 per cent total solids, so that the statute standard is placed at the average quality of milk, the milk of the distinctive butter breeds of cows ranging over 14 and often as high as 15 per cent. Should any change be deemed advisable, we feel that the one which would be of the most value would be to add a fat standard of 3.75. The study of the composition of milk has been carried to such an extent by experiment stations and others all over the country that it is well known that the amount of solids not fat in milk is quite uniform, the element which shows the most variation being the fat. There is also, within limits, quite a constant ratio between the solids not fat, and fat. In a sample of milk containing 3 per cent of fat we should look for somewhere in the neighborhood of 11 per cent of total solids. With 3.5 per cent of fat we should expect the total solids to be approximately 12 to 12.5 per cent. If milk has 3.75 to 4 per cent of fat, it will be up to the standard or above. The Babcock milk tester gives such an easy way of testing for fat that a statute recognition of the fact that normal 13 per cent milk has 3.75 per cent of fat would allow every farmer to test his own milk and keep track of the quality he is sending to the city, with an assurance that the milk is up to the standard.

Another reason for asking for this change is given in the following quotation from the report of Dr. Harrington, the Boston milk inspector, which meets the views of this department: —

> Another fraud which the present law does not reach, but which nevertheless is a serious fraud, has been discovered during the past year. The milk sold by certain dealers has shown a peculiar composition, inconsistent with that of genuine milk, and yet conforming to the statute requirement. While containing the necessary 13 per cent of milk solids, a decidedly low percentage of fat, with an abnormally high percentage of solids not fat, were noticed. On investigation, it was learned that a large business was being conducted with a New York house which sells condensed skim-milk obtained from the New York creameries. This skim-milk, which is in

a sense a waste product, is concentrated or "condensed" by evaporation in vacuum pans, and then sold to milkmen, who, after robbing their milk of a part of its cream, add enough of the concentrated skim-milk, containing almost wholly non-fatty substances, to bring the yield of total solids above the statute requirement. Thus a milk which has lost a valuable constituent is made to conform with the law. No provision in the existing law can reach this fraud, for two reasons: first, the removal of the cream, or a part thereof, can hardly be legally proven unless the operation has been actually observed; and, second, the substance added is in no sense foreign to milk. There is, however, a way to meet and prevent the deception, and that is, to establish a standard for fat; and the bill already referred to fixes this at 3.70 per cent. If this shall pass, there will no longer be any reason for adding non-fatty solids.

Another change in the law, which might be of advantage both to consumers and producers, would be in relieving the Board of Health from the arbitrary requirement that they expend a certain amount for the investigation of dairy products. The creation of the Dairy Bureau and the increased popular attention given to health matters lead to this suggestion. Our present laws relate almost wholly to commercial frauds, and have but little if anything to do with health matters. Under the present statute the Board of Health is compelled to divert a certain amount of its appropriation from health work to work in detecting commercial frauds. This work could be as well done by the Dairy Bureau, and the transfer would leave the Board of Health with greater resources to investigate some of the great health problems in connection with the milk supply which are now pressing upon the public attention.

The law requiring us to work in harmony with milk inspectors has produced good results, and we are indebted to Dr. Harrington and the milk inspectors of a number of cities other than Boston for much valuable information given to us. We wish that this department of the work of the Bureau could be extended and broadened, so that, without encroaching in the least upon the prerogatives of the local officers in the different cities, this office could be a clearing house for an interchange of information, and for giving to the Legislature in its annual reports the best suggestions which these various local officers annually make to their respective city governments.

In the year 1894 the annual agitation for a reduction in the milk standard resulted in a compromise measure, which appeared on the surface to be a harmless though useless piece of legislation, enacting into a statute certain requirements as to the taking of samples which had already been in force through the operation of the well-established laws of evidence. This statute was opposed by the Bureau on the ground, first, that it was unnecessary, and second, that it might contain some loopholes through which dishonest milkmen would gain a point. The law was so objectionable that the governor refused to sign it, though he allowed it to become operative by the lapse of time without a veto. The law alluded to is chapter 425 of the Acts of 1894, and is as follows: —

> No producer of milk shall be liable to prosecution on the ground that the milk produced by him is not of good standard quality, unless the milk alleged not to be of such quality was taken upon the premises or while in the possession or under the control of the producer by an inspector of milk or by the agents of the Dairy Bureau or State Board of Health, or collector of samples duly authorized by such inspector, and a sealed sample of the same given to the producer.

In the trial of a case where the defendant was charged with having in his possession milk below the standard quality, the evidence tended to prove that the defendant was the producer of the milk in question, and, at the time the sample was taken from his servant, was at his farm in another city. The court was asked to rule that there was a variance between the complaint and the proof, and that the evidence would not warrant a verdict of guilty. The court declined so to rule; the defendant was convicted; exceptions were taken and overruled by the supreme court. In its opinion the supreme court said: —

> It is the general rule of law that the possession of a servant is the possession of the master. In the present case, we think that

the evidence showed that the milk was still in the possession and under the control of the defendant. Statutes of 1894, chapter 425, was designed to exempt a producer of milk from prosecution on a complaint that the milk was not of good standard quality only when the milk was found on other premises than those of the producer; or in the possession of another person than the producer, who was not subject to the control of the producer, and who, therefore, might have adulterated the milk for his own purposes; or when milk, if found upon the premises or in the possession or under the control of the producer, was taken by some person who was not an inspector of milk or an agent of the Dairy Bureau or State Board of Health, or a collector of samples duly authorized by an inspector, and who, therefore, might not be trustworthy. In every case of a taking of milk a sealed sample of the milk taken must be given to the producer for his protection. There is no indication that the general law governing the responsibility of a master for the acts of his servant was intended to be affected by the statute.

INSTITUTE WORK.

Nineteen farmers' meetings have been addressed by the acting executive officer of the Bureau during the past year. In most of these the Babcock tester was used in testing samples of milk brought to the meeting, its use explained, with its value to dairymen, whether producing milk for the market or making butter. One hundred and nineteen samples of milk were tested in such demonstration talks. The following are the statistics of the samples tested: —

3.4 per cent of fat and below, ...	13 per cent of samples.
3.6 to 3.8 per cent of fat (on the line of the legal standard), ...	25 per cent of samples.
4 to 5 per cent of fat, ...	42 per cent of samples.
Above 5 per cent of fat, ...	20 per cent of samples.
	100

THE BAY STATE FAIR.

The annual agricultural fair at Worcester this year was a State fair. Being such, the Dairy Bureau was invited to take charge of the dairy department, and the acting executive officer was appointed superintendent. The exhibits of butter, cheese and the dairy machinery were grouped in one room, so that persons interested in dairying could find in one place all that the exhibition had to offer in that line. The specimens of butter were scored by Mr. George D. Fales of Boston. After the scoring, samples were taken for chemical analysis. We submit below the result of the scoring, and the analyses of samples which took premiums: —

CREAMERY PRINTS.

EXHIBITORS.	Score.	ANALYSIS.			
		Water.	Fat.	Salt.	Curd.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.
Worcester County Creamery, .	97½	10.98	85.28	2.54	1.20
Montague Creamery, . .	97	10.52	86.42	2.20	.86
E. S. Cove, Phillipston, . .	94¾	–	–	–	–

DAIRY PRINTS.

F. W. Field & Son, Somers, Conn., ...	97½	9.17	88.49	1.57	.77
W. F. Wilder, Rindge, N. H., .	97¼	7.98	87.82	2.40	1.90
N. I. Bowditch, Framingham, .	96¼	9.71	87.57	2.25	.57

CREAMERY TUBS.

Rockside Creamery, Altoona, N. Y., ...	96	8.73	88.80	2.12	.35
Worcester County Creamery, .	95½	12.86	84.03	2.62	1.49
Montague Creamery, . .	95¼	10.08	87.39	1.95	.58

DAIRY TUBS.

J. A. Cunningham, Bolton, .	96½	9.10	88.55	1.31	1.04

DAIRY BOXES.

J. A. Cunningham, Bolton, .	96½	–	–	–	–
Mrs. Mary L. Sawyer, Sterling,	92½	–	–	–	–
N. I. Bowditch, Framingham, .	92	–	–	–	–
E. J. Dana, North Pomfret, Vt.,	92	–	–	–	–

In the dairy building, but having no connection with the department under the superintendency of the Bureau, took place the churning of the cream from the cows contesting for the butter premiums. The cows were milked on the grounds, the milk placed in charge of a butter maker, who superintended its ripening, and the second day it was churned, each competitor being allowed to churn his own cream, if he desired. Samples of buttermilk were taken by the representative of the Bureau and tested in the Babcock tester. Startling amounts of fat were found in the buttermilk, showing that the prize was awarded for the most skilful manipulation of the cream, rather than for the cow producing the most butter. The results were so important and startling that they have attracted the attention of the dairy press over the whole country. The statistics are given in the following table : —

OWNER.	Cow's Name.	Weight of Milk.		Weight of Butter.		Fat in Buttermilk.	Analysis of Butter.		
							Fat.	Curd.	Water.
		lbs.	oz.	lbs.	oz.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
C. H. Ellsworth,	herd,	168	6	9	8½	.80	78.27	1.00	21.73
L. J. Kendall,	herd,	114	7	5	9	1.20	81.11	2.04	18.89
J. B Palmer,	herd,	60	8½	2	8	1.20	82.18	.80	17.82
J. W. Andrews,	Lady Kate,	38	1½	1	12	.50	81.61	.53	17.86
H. McKay Twombly,	Cocoa,	–	–	1	10	1.40	72.21	.28	27.51
C. H. Ellsworth,	Brownie,	33	1½	1	9½	.80	82.10	.98	16.92
J. W. Andrews,	Lady Amy,	25	3	1	8	.20	84.34	.66	15.00
H. McKay Twombly,	Rutilla's daughter,	26	5	1	8	.60	80.78	.82	18.60
N. I. Bowditch,	103,	31	15½	1	7	3.40	82.10	.60	17.30
N. I. Bowditch,	195,	32	2	1	6	3.40	81.35	.62	18.03
J. A. Cunningham,	Fenella,	24	9½	1	6	.20	86.46	1.17	12.37
J. A. Cunningham,	Edith,	30	6	1	3½	1.00	85.61	.31	14.62
L. J. Kendall,	Lilly,	25	11		11	3.40	83.91	.52	15.57
L. J. Kendall,	Pearl,	25	3½		5	5.00	83.25	.49	16.26

On the whole, the dairy department of the fair was considered very successful.

PROPER TESTING OF COWS AT FAIRS.

In connection with the proper method of testing cows at fairs, the Bureau has used its influence to bring about a reform, and to impress the dairy community with the fact that a cow is to be valued for the amount of milk solids she produces, rather than for the amount of water which may be drawn from her udder. Growing out of our suggestion, the Worcester South Agricultural Society offered premiums for the cow producing the greatest amount of butter fat on the grounds of the society during twenty-four hours. This is virtually equivalent to a prize for the cow producing the greatest amount of total solids, for, the fat being the varying element, the cow that produces the greatest amount of fat will necessarily produce the greatest amount of total solids. The awarding of this premium was left with the representative of the Bureau, with the following results: —

OWNER.		Weight of Milk.		Per Cent of Fat.	Ounces of Fat produced.	Mathematical Equivalent of Fat in Butter.	
		lbs.	oz.			lb.	oz.
L. Crawford, New Braintree, seven-year-old thoroughbred Jersey, giving milk three weeks.	evening,	10	14	6.0	10.4		–
	morning,	10	12	5.8	10.0		–
		21	10		20.4	1	8
L. W. Woodis, Brookfield, grade Ayrshire, calved August 1.	evening,	16	8	3.6	9.5		
	morning,	16	9	3.8	10.0		–
		33	1		19.5	1	7
C. D. Richardson, West Brookfield, thoroughbred Jersey.	evening,	10		5.0	8.0		–
	morning,	8	14	5.0	7.0		–
		18	14		15.0	1	1½
L. Crawford, New Braintree, eight-year-old grade Guernsey, in milk since May 1.	evening,	9	14	4.6	5.9		–
	morning,	9	15	4.8	7.6		–
		19	13		13.5	1	
Geo. W. Sherman, Brookfield.	evening,	1	13	4.0	1.2		–
	morning,	2	8	5.4	2.2		–
					3.4		4

HOME DAIRY TESTS.

The Bay State Society, working along this same line, but carrying the idea a step farther, has offered prizes for cows producing the greatest amount of butter fat, the tests to be made at the homes of the competitors, with cows surrounded by normal conditions, rather than with the excitement and confusion of exhibition grounds. The results of this work are as follows: —

Herd of Herbert Merriam of Weston.

COWS.		Weight of Milk. lbs.	Weight of Milk. oz.	Per Cent of Fat.	Weight of Fat. lbs.	Total (Pounds).
Yellow Lily, . .	Thursday, P.M., . .	12	6	5.0	.618	–
	Friday, A.M., . .	12	4	5.6	.686	–
	Friday, P.M., . .	12	2	4.6	.558	–
	Saturday, A.M., . .	11		5.4	.594	–
				5.15		2.456
Polly of Lincoln, .	Thursday, P.M., . .	17	6	3.8	.660	–
	Friday, A.M., . .	13	12	4.2	.577	–
	Friday, P.M., . .	15	11	4.0	.627	–
	Saturday, A.M., . .	14		4.4	.561	–
				4.10		2.425
Polly of Nobility, .	Thursday, P.M., . .	13	6	4.6	.615	–
	Friday, A.M., . .	10	1	5.2	.523	–
	Friday, P.M., . .	12	14	4.6	.592	–
	Saturday, A.M., . .	11	1	5.8	.642	–
				5.05		2.373
Polly of Lincoln, 3d,	Thursday, P.M., . .	11	12	5.0	.587	–
	Friday, A.M., . .	11	7	6.0	.686	–
	Friday, P.M., . .	11	8	4.6	.529	–
	Saturday, A.M., . .	10	1	4.6	.463	–
				5.05		2.265
Polly of Concord, .	Thursday, P.M., . .	9	11	4.8	.465	–
	Friday, A.M., . .	8	14	4.8	.426	–
	Friday, P.M., . .	10	2	4.8	.486	–
	Saturday, A.M., . .	9	8	5.6	.532	–
				5.00		1.909
Total for herd, ...				. .	. .	11.428

Herd of N. B. Douglas of Sherborn.

Daisy, . . .	Thursday, P.M., . .	14	10	4.4	.644	–
	Friday, A.M., . .	12	11	4.2	.533	–
	Friday, P.M., . .	14	1	4.2	.591	–
	Saturday, A.M., . .	12	14	4.4	.567	–
				4.30		2.335

Herd of N. B. Douglas of Sherborn — Concluded.

COWS.		Weight of Milk.		Per Cent of Fat.	Weight of Fat.	Total (Pounds).
		lbs.	oz.		lbs.	
Hilda,	Thursday, P.M.,	12	14	4.4	.567	–
	Friday, A.M.,	12	5	4.4	.542	–
	Friday, P.M.,	13	2	4.4	.578	–
	Saturday, A.M.,	11	12	4.6	.541	–
				4.45		2.228
Biscuit,	Thursday, P.M.,	10		5.0	.500	–
	Friday, A.M.,	9	6	6.4	.600	–
	Friday, P.M.,	10		5.4	.540	–
	Saturday, A.M.,	8	10	4.2	.362	–
				5.25		2.002
Gretchen,	Thursday, P.M.,	11	12	4.6	.541	–
	Friday, A.M.,	10	1	5.0	.503	–
	Friday, P.M.,	11	2	4.4	.489	–
	Saturday, A.M.,	10		4.0	.400	–
				4.50		1.933
Pansy,	Thursday, P.M.,	8	8	5.2	.442	–
	Friday, A.M.,	10		5.4	.540	–
	Friday, P.M.,	8	8	5.4	.459	–
	Saturday, A.M.,	7	12	4.4	.341	–
				5.10		1.782
Total for herd,						10.280

BOSTON MILK SUPPLY.

The following is the number of cans of milk received and sold by the milk contractors of Boston, who supply at least three-fourths of the milk sold in the "greater Boston." The cans contain 8½ quarts each.

	Received.	Sold.	Surplus.
January,	801,457	621,049	180,408
February,	730,937	563,039	167,898
March,	860,757	631,527	229,230
April,	861,524	656,943	204,581
May,	934,871	710,823	224,048
June,	918,079	704,364	213,715
July,	801,285	721,618	79,667
August,	771,628	701,149	70,479
September,	758,131	699,140	58,991
October,	820,454	679,128	141,326
November,	782,071	687,530	94,541
December,	815,306	664,422	150,884
Total,	9,856,500	8,040,732	1,815,768
1894,	9,705,447	7,657,421	2,048,026
1893,	9,263,487	7,619,722	1,643,765
1892,	9,212,667	7,315,135	–

Continuous Milk Tests.

Last year we reported investigations made by Mr. Clemence of the Bureau on the quality of the milk furnished by his herd. These investigations have been continued during the year, and we regard the result as very valuable. Mr. Clemence is a milk dealer retailing his own production, and has a herd of grade cows purchased from different sources as necessary to keep up his supply. While he is desirous of having cows which give as much milk as possible, he is also desirous that the milk shall be of reasonable quality. Nearly two years of monthly tests of mixed milk of his herd show that it is very uniform, varying less than three-tenths of one per cent, regardless of the season of the year or the kind of feed. This proves that, under such conditions as exist in Mr. Clemence's case, common cows will give milk up to the statute standard, and that there are no mysterious variations from a comparatively uniform quality. The percentage of fat has ranged between 4.2 and 4.4 per cent by the Babcock test. Several samples of milk, submitted to chemical analysis for the purpose of verifying the Babcock test, and showing indisputably what such milk ought to contain of total solids, have resulted in a range of from 13.52 to 13.84 per cent of solids. This verifies what the Bureau has frequently stated, that milk of 3.75 per cent of fat is, if normal, up to the standard, and it shows that there is no difficulty in producing standard milk.

Miscellaneous.

The Bureau has been represented at two dairy conferences of a national nature, and in one case its acting executive officer was invited to prepare a paper. He has also done some work for the milk interests of the State, as secretary of the Milk Producers' Union.

Financial Statement.

The following is the financial statement of the expenses of the Bureau during the past year: —

Appropriation by Legislature of 1895,		$7,000 00
Members of the Bureau, travelling expenses and attending meetings,	$326 80	
George M. Whitaker, travelling and other expenses,	624 23	
Agents' salaries,	1,807 66	
Agents' expenses,	1,434 57	
Chemical work,	1,670 00	
Educational work,	150 66	
Legal advice,	105 00	
Printing,	79 30	
Supplies,	85 23	
Total,	$6,283 45	
Unexpended balance,	716 55	
	$7,000 00	

Respectfully submitted,

GEO. M. WHITAKER,
Acting Executive Officer.

Approved and adopted as the report of the Dairy Bureau.

C. L. HARTSHORN.
GEO. L. CLEMENCE.
DWIGHT A. HORTON.

BOSTON, Jan. 15, 1896.

FINANCIAL RETURNS

AND

ANALYSES OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH MEMBERSHIP AND INSTITUTES
FOR THE YEAR 1895.

RETURNS OF SOCIETIES.

AMESBURY AND SALISBURY AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1881, Acts of 1881, chapter 204.

Originally raised by contribution $1,002.32; now has $7,392.72 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $8,070.32: real estate, $7,392.72; crockery, tables, etc., $269.89; bills due, $50; cash on hand, $357.71. Total liabilities consist of notes amounting to $1,900. Receipts in 1895, $2,036.36: bounty, $600; rent, $87; new members, $18; donations, $60; other sources, $1,271.36. Expenditures in 1895, $1,823.92: premiums and gratuities paid, $887.03; current running expenses, $123.17; interest, $114; other expenses, $699.72. The society offered $1,500 in premiums and awarded and paid $887.03 in premiums and gratuities, which went to 16 cities and towns. One hundred and twenty-eight dollars and seventy-five cents went to 4 towns outside the State. Three hundred and twenty-five persons received premiums and 261 gratuities. Under head of farms $21 was awarded and paid; under farm and pet stock $433 was awarded and paid; under farm and garden products $174.20 was awarded and paid; under dairy products $3.25 was awarded and paid; under domestic manufactures $93.80 was awarded and paid; under objects strictly agricultural, not specified, $96.53 was awarded and paid; under objects other than agricultural, not specified, $57.25 was awarded and paid. The society reports 229 members, — 202 males and 27 females. Three farmers' institutes were held at Amesbury: January 17, on "Animal structure with special reference to purpose" and "The horse and how to measure his value;" February 6, on "Fruit culture" and "Poultry;" and March 13, on "Progressive farming" and "Farming as a business."

BARNSTABLE COUNTY AGRICULTURAL SOCIETY.

Incorporated 1844, Acts of 1844, chapter 114.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $1,740; now has $8,300 invested as a capital stock in real estate and bonds. Total assets, $8,558.90: real estate, $7,500; bonds, $800; cash on hand, $258.90. Total liabilities consist of notes amounting to $3,575. Receipts in 1895, $3,524.83: bounty, $600; new members, $25; other sources, $2,899.83. Expenditures in 1895, $3,265.93: premiums and gratuities paid, $1,506.50;* current running expenses, $1,557.43; interest, $202. The society offered $1,953.50 in premiums and awarded and paid $1,506.50* in premiums and gratuities, which went to 9 towns. Ninety-three persons received premiums and 119 gratuities. Under head of farm and pet stock $319.25 was awarded and paid; under field and garden crops $3 was awarded and paid; under farm and garden products $252.50 was awarded and paid; under dairy products $8 was awarded and paid; under domestic manufactures $121.25 was awarded and paid; under agricultural implements $3 was awarded and paid; under trotting $782.50 was awarded and paid; under objects other than agricultural, not specified, $17.50 was awarded and paid. The society reports 589 members, — 358 males and 231 females. Three farmers' institutes were held: at Yarmouthport, January 30, on "Practical poultry culture;" at East Sandwich, February 28, on "Small fruits;" and at Buzzard's Bay, December 17, on "The management of a dairy farm and care of milch cows."

BERKSHIRE AGRICULTURAL SOCIETY.

Incorporated 1811, Acts of 1811, chapter 70.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $3,000; now has $12,000 invested as a capital stock in real estate. Total assets, $12,569.94: real estate, $12,000;

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* Of this amount $782.50 was paid for trotting.

crockery, tables, etc., $200; bills due and unpaid, $345.34; cash on hand, $24.60. Total liabilities, $5,679.44: outstanding bills, $679.44; mortgages or like liabilities, $5,000. Receipts in 1895, $11,597.02: bounty, $600; new members, $103; other sources, $10,894.02. Expenditures in 1895, $11,572.42: premiums and gratuities paid, $1,297.75; current running expenses, $5,274.67; interest, $858; other expenses, $4,142. The society offered $1,811.50 in premiums, and awarded and paid $1,297.75 in premiums and gratuities, which went to 30 cities and towns. Thirty-six dollars went to 4 towns outside the State. Three hundred and ninety persons received premiums and gratuities. Under head of farms $14 was awarded and paid; under farm and pet stock $732 was awarded and paid; under farm and garden products $234 was awarded and paid; under dairy products $18 was awarded and paid; under domestic manufactures $209 was awarded and paid; under trotting $1,637.50 was paid; under objects other than agricultural, not specified, $74 was awarded and paid. The society reports 1,080 members, 983 males and 97 females. Three farmers' institutes were held: at Pittsfield, January 25, on "Tuberculosis and the work of the Cattle Commission;" at Lee, March 12, on "The cost of a quart of milk" and "Cattle foods;" and at Richmond, March 22, on "Practical agriculture," "Dairying" and "Fruit raising."

BLACKSTONE VALLEY AGRICULTURAL SOCIETY.

Incorporated 1884, Acts of 1884, chapter 48.

Originally raised by contribution $3,000; now has $4,500 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $4,500.10: real estate, $4,400; crockery, tables, etc., $100; cash on hand, $0.10. Total liabilities, $1,689: premiums due and unpaid, $63; outstanding bills, $26; mortgages or like liabilities, $1,600. Receipts in 1895, $1,893.61: bounty, $600; new members, $28; donations, $15.95; all other sources, $1,249.66. Expenditures in 1895, $1,912.01: premiums and gratuities paid,

$722; current running expenses, $1,125.01; interest, $65. The society offered in premiums $962.55, and awarded $785 in premiums and gratuities, of which amount $722 was paid to 21 cities and towns. Eleven dollars went to 1 city and 2 towns outside the State. One hundred and thirty-five persons received premiums and 21 gratuities. Under head of farms $96 was awarded and paid; under farm and pet stock $479 was awarded and paid; under field and garden crops $46.75 was awarded and paid; under farm and garden products $73.50 was awarded and paid; under dairy products $8 was awarded and paid; under domestic manufactures $56.35 was awarded and paid; $49.35 was awarded for objects other than agricultural, not specified. Eighty-five dollars was paid for trotting. The society reports 502 members, — 285 males and 217 females. Three farmers' institutes were held at Uxbridge: January 11, on "Tuberculosis in cattle;" February 28, on "History of organized agriculture in the United States;" and April 6, on "The horse's foot and its diseases."

BRISTOL COUNTY AGRICULTURAL SOCIETY.

Incorporated 1823, Acts of 1823, chapter 32.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $3,240; now has $32,000 invested as a capital stock in real estate. Total assets, $34,388.87: real estate, $32,000; crockery, tables, etc., $200; cash on hand, $2,188.87. Total liabilities, $14,073.45: premiums due and unpaid, $73.45; mortgages or like liabilities, $14,000. Receipts in 1895, $17,565.74: bounty, $600; new members, $60; all other sources, $16,905.74. Expenditures in 1895, $15,376.87: premiums and gratuities paid, $5,287.97; current running expenses, $6,910.45; interest, $843.08; other expenses, $2,335.37. The society offered $6,546.23 in premiums, awarded $5,361.42 in premiums and gratuities and paid $5,287.97, which went to 49 cities and towns. Five hundred and twenty-five dollars and twenty-five cents went to 6 cities and 9 towns outside the State. Six hundred and forty-nine persons received premiums and 45 gratuities. Under head of farms $58 was awarded and paid; under farm and pet stock $1,728.25 was awarded and $1,678 paid; under field and garden crops $65 was awarded and paid; under farm and garden products $352.75 was awarded and paid; under dairy products $42 was awarded and paid; under domestic manufactures $339.65 was awarded and $316.25 paid; under objects other than agricultural $140 was awarded and paid. Eight hundred and twenty dollars was paid for trotting. The society reports 881 members,—688 males and 193 females. Three farmers' institutes were held: at Dighton, March 7, on "What we know about plant food" and "Labor;" at Raynham, March 13, on "How to keep up the fertility of our farms" and "General farming;" and at New Bedford, March 22, on "Bacteria," "Labor strikes" and "Successful farming."

DEERFIELD VALLEY AGRICULTURAL SOCIETY.

Incorporated 1871, Acts of 1871, chapter 208.

Originally raised by contribution $4,094.01; now has $9,200 invested as a capital stock in real estate. Total assets, $9,576.24: real estate, $9,200; crockery, tables, etc., $250; cash on hand, $126.24. Liabilities consist of outstanding bills to the amount of $1,075. Receipts in 1895, $2,034.94: bounty, $600; new members, $60; donations, $27.95; other sources, $1,346.99. Expenditures in 1895, $1,908.70: premiums paid, $979.40; current running expenses, $875.54; interest, $53.76. The society offered in premiums $1,236.50, awarded $1,007.35 and paid $979.40, which went to 25 towns. Nine dollars and fifty-five cents went to 4 towns outside the State. Two hundred and fifty-three persons received premiums. Under head of farm and pet stock $556 was awarded and $532.75 paid; under farm and garden products $72 was awarded and $70.65 paid; under dairy products $28 was awarded and $26 paid; under domestic manufactures $77.35 was awarded and $76 paid; under trotting $230 was paid; under objects other than agricultural, not specified, $44 was awarded and paid. The society reports 1,346 members, — 1,231 males and 115 females. Three farmers' institutes were held; at Charlemont, January 23, on "Manures and Fertilizers;" at Ashfield, February 27, on "Corn culture" and "The silo and ensilage;" and at Colrain, November 30, on "Tuberculosis."

EASTERN HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 156.

Originally raised by contribution $3,000; now has $7,000 invested as a capital stock in real estate. Total assets, $7,005.55: real estate, $7,000; cash on hand, $5.55. Total liabilities, $3,359.45: outstanding bills, $625; mortgages or like liabilities, $2,734.45. Receipts in 1895, $2,503.33: bounty, $600; new members, $69; donations, $51.08; other sources, $1,783.25. Expenditures in 1895, $3,146.32: premiums and gratuities paid, $1,935.48; current running expenses, $1,210.84. The society offered $2,423.80* in premiums and awarded and paid $1,935.48* in premiums and gratuities, which went to 21 cities and towns. Five hundred and sixty-five dollars went to 4 cities and towns outside the State. One hundred and twenty-three persons received premiums and gratuities. Under head of farms $10 was awarded and paid; under farm and pet stock $469 was awarded and paid; under farm and garden products $158.05 was awarded and paid; under dairy products $14 was awarded and paid; under domestic manufactures $47.43 was awarded and paid; under trotting $1,220 was awarded and paid; under objects other than agricultural, not specified, $17 was awarded and paid. The society reports 467 members, — 273 males and 194 females. Three farmers' institutes were held: at Palmer, January 8, on "Cultivation of grasses;" at Monson, February 12, on "Barn-yard manures and commercial fertilizers;" and at Palmer, March 12, on "General fruit culture."

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* Of these amounts $1,220 was for trotting or pacing classes.

ESSEX AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 25.

The society in its first report to the Board in 1853 reported the amount of its permanent fund (par value) to be $9,363.66; now has $20,533.05 invested as a capital stock in real estate, stocks, bonds, crockery, tables, etc. Total assets, $20,533.05: real estate, $5,000; stocks, $14,333.05; bonds, $1,000; crockery, tables, etc., $200. Receipts in 1895, $2,151.98: bounty, $600; stocks, $858.84; bonds, $59.50; new members, $69; other sources, $564.64. Expenditures in 1895, $2,922.33: premiums paid, $1,732.75; current running expenses, $1,013.33; interest, $176.25. The society offered in premiums $2,319.75, awarded $1,844.50* and paid $1,732.75,* which went to 32 cities and towns. Three hundred and twenty-four persons received premiums. Under head of farms $66 was awarded and $107 paid; under farm and pet stock $382 was awarded and $693 paid; under field and garden crops $91 was awarded and $155 paid; under farm and garden products $308 was awarded and $494.50 paid; under dairy products $24 was paid; under domestic manufactures $133.25 was awarded and $142.50 paid; under agricultural implements $30 was awarded and $50.50 paid; under objects strictly agricultural, not specified, $73 was paid; under objects other than agricultural, not specified, $67.75 was awarded and $93 paid. The society reports 1,520 members, — 1,503 males and 17 females. Four farmers' institutes were held: at Danvers, January 5, on "Rural hygiene" and "Cooking;" at Topsfield, January 25, on "Fruit growing and small fruits," "Flowers" and "Agriculture and trade;" at Newbury, February 15, on "Tuberculosis in cattle;" and at Beverly, March 8, on "Cattle and cattle feeds."

FRANKLIN COUNTY AGRICULTURAL SOCIETY.

Incorporated 1850, Acts of 1850, chapter 104.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,768;

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* Amounts paid for 1894; awarded for 1895.

now has $8,520 invested as a capital stock in real estate and bank stock. Total assets, $8,770.69: real estate, $7,500; stock, $1,020; bank funds, $114.69; crockery, tables, etc., $75; cash on hand, $61. Total liabilities, $1,121.81: premiums due and unpaid, $48.90; outstanding bills, $172.91; mortgages or like liabilities, $900. Receipts in 1895, $4,954.70: bounty, $600; stocks, $32.11; new members, $5; donations, $312.38; other sources, $4,004.21. Expenditures in 1895, $5,571.94: premiums and gratuities paid, $2,717.90; current running expenses, $1,823.54; interest, $13.75; other expenses, $1,016.75. The society offered in premiums $3,179.50, awarded in premiums and gratuities $2,766.80* and paid $2,717.90,* which went to 23 towns. Twenty-five cents went to 1 town outside the State. Three hundred and forty-three persons received premiums and 18 gratuities. Under head of farm and pet stock $952.50 was awarded and $921 paid; under farm and garden products $178.30 was awarded and $167.65 paid; under dairy products $10 was awarded and $3 paid; under domestic manufactures $133.50 was awarded and $128 paid; under trotting $1,460 was awarded and paid; under objects other than agricultural, not specified, $29.50 was awarded and $28.25 paid. Diplomas were awarded for agricultural implements. The society reports 1,800 members, — 1,500 males and 300 females. Three farmers' institutes were held: at Greenfield, February 21, on "The horse for to-morrow;" at Greenfield, March 2, on "Manures and fertilizers and their use;" and at Montague, March 15, on "The management of a dairy farm."

HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1844, Acts of 1844, chapter 56.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $4,860; now has $1,678.28 invested as a capital stock in real estate, crockery, tables, etc., bills due and unpaid and cash on hand. Total assets, $1,678.28: real estate, $800; crockery, tables, etc., $150; bills due and unpaid, $225; cash on hand, $503.28. Liabilities consist of outstanding bills to the amount of $500. Receipts in 1895, $1,650.65: bounty, $228.80; new members, $27.50; donations, $95.38; other sources, $1,298.97. Expenditures in 1895, $1,286.72: premiums and gratuities paid, $384.53; current running expenses, $397.50; other expenses, $504.69. The society offered in premiums $1,378; awarded in premiums and gratuities $485.60 * and paid $384.53,* which went to 14 cities and towns. One dollar and fifty cents went to 1 town outside the State. Eighty persons received premiums and 5 gratuities. Under head of farms $40 was awarded and $10 paid; under farm and pet stock $195.50 was awarded and $131.75 paid; under field and garden crops $2 was awarded; under farm and garden products $120.75 was awarded and $71.25 paid; under domestic manufactures $28.50 was awarded and $21.63 paid; under objects strictly agricultural, not specified, $15 was awarded and paid; under trotting $160 was paid; under objects other than agricultural, not specified, $17.50 was awarded and $17.25 paid. Diplomas were awarded for agricultural implements and for certain farm stock. The society reports 619 members, — 478 males and 141 females. Three farmers' institutes were held: at Springfield, January 2, on "Tuberculosis;" at Agawam, January 31, on "Feeding dairy stock" and "Profitable garden crops;" and at Wilbraham, February 27, on "Small fruits."

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* Of these amounts $1,460 was for trotting and pacing for premiums.

HAMPSHIRE AGRICULTURAL SOCIETY.

Incorporated 1814, Acts of 1814, chapter 19.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $3,255.26; now has $4,352.43 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $4,408.16: real estate, $4,200; crockery, tables, etc., $152.43; cash on hand, $55.73. Total liabilities amount to $967. Receipts in 1895, $1,268.80: bounty, $600; new members, $32.50; donations, $43.10; other sources, $593.20. Expenditures in 1895, $1,762.12: premiums and gratuities paid, $650.19; current running expenses, $566.93; interest, $54.70; other expenses, $490.30. The society offered in premiums $932, awarded in premiums and gratuities $693.29 and paid $650.19, which went to 16 cities and towns. One hundred and nineteen persons received premiums and 13 gratuities. Under head of farm and pet stock $258 was awarded and $246 paid; under field and garden crops $48.50 was awarded and paid; under farm and garden products $151 was awarded; under dairy products $8 was awarded and paid; under domestic manufactures $20 was awarded and paid; under trotting $545 was paid; under objects other than agricultural, not specified, $10 was awarded. The society reports 803 members, — 567 males and 236 females. Three farmers' institutes were held: at Amherst, March 9, on "The dairyman;" at Belchertown, April 20, on "Manures and fertilizers and their use;" and at Amherst, December 28, on "The Atlanta exposition and Farmers' National Congress; what I saw and heard there."

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* Of these amounts $160 was for trotting.

HAMPSHIRE, FRANKLIN AND HAMPDEN AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 125.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $8,141.29; now has $3,316.57 invested as a capital stock in personal property. Total assets, $3,316.57: real estate lease, $2,000; crockery, tables, etc., $600; cash on hand, $716.57. Total liabilities amount to about $150. Receipts in 1895, $4,050.96: bounty, $600; new members, $62; other sources, $3,388.96. Expenditures in 1895, $3,334.39: premiums and gratuities paid, $848.50; current running expenses, $859.67; interest, $20; other expenses, $1,606.22. The society offered in premiums $1,253, awarded in premiums and gratuities $923 and paid $848.50, which went to 28 cities and towns. One hundred and eighty-seven persons received premiums and 11 gratuities. Under head of farm and pet stock $589.40 was awarded and $552.15 paid; under field and garden crops $24 was awarded and $18 paid; under farm and garden products $182 was awarded and $169 paid; under dairy products $17 was awarded and paid; under domestic manufactures $83.60 was awarded and $69.85 paid; under agricultural implements $15 was awarded and $13.50 paid; under objects other than agricultural, not specified, $12 was awarded and $9 paid; under trotting $700 was paid. The society reports 1,000 members, — 750 males and 250 females. Four farmers' institutes were held: at Northampton, January 2, on "The farmers' movement;" at Williamsburg, January 30, on "The apple as a money crop in New England" and "The scale of points and score card for awarding prizes at agricultural exhibitions;" at South Hadley, February 22, on "How to feed the dairy cow for milk and cream production and what to do with the skimmed milk" and "Summer forage crops;" and at Easthampton, March 19, on "Home markets for home products" and "Massachusetts agriculture."

HIGHLAND AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 145.

Originally raised by contribution $3,262; now has $3,150 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $3,171.08: real estate, $3,000; crockery, tables, etc., $150; cash on hand, $21.08. Receipts in 1895, $1,600.08: bounty, $600; new members, $17; donations, $2; other sources, $981.08. Expenditures in 1895, $1,579: premiums paid, $650.95; current running expenses, $920.55; interest, $7.50. The society offered in premiums $854.55 and awarded and paid $650.95,* which went to 23 cities and towns. One dollar went to 1 town outside the State. One hundred and seventy-four persons received premiums. Under head of farm and pet stock $392.50 was awarded and paid; under field and garden crops $32 was awarded and paid; under farm and garden products $40.50 was awarded and paid; under dairy products $7.50 was awarded and paid; under domestic manufactures $69.70 was awarded and paid;

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* Of this amount $64 was for trotting premiums.

under objects other than agricultural, not specified, $44.75 was awarded and paid; under trotting $64 was awarded and paid. The society reports 428 members, — 299 males and 129 females. Three farmers' institutes were held: at Middlefield, February 1, on "Growing and feeding forage crops;" at Chester, June 15, on "Equal taxation;" and at Middlefield, September 4, on general topics.

HILLSIDE AGRICULTURAL SOCIETY.

Incorporated 1883, Acts of 1883, chapter 112.

Originally raised by contribution $3,113.32; now has $5,754.70 invested as a capital stock in real estate, fixtures and cash. Total assets, $5,754.70: real estate, $4,660.61; bank funds, $490.10; bills due and unpaid, $404.35; cash on hand, $199.64. Receipts in 1895, $1,781.58: bounty, $600; bank funds, $24.60; new members, $160; donations, $30.03; other sources, $966.95. Expenditures in 1895, $1,341.08: premiums paid, $739.60; current running expenses, $601.48. The society offered in premiums $788 and awarded and paid $739.60,* which went to 26 cities and towns. Three hundred and seventy-one persons received premiums. Under head of farms $6 was awarded and paid; under farm and pet stock $440.75 was awarded and paid; under field and garden crops $43 was awarded and paid; under farm and garden products $70.60 was awarded and paid; under dairy products $13 was awarded and paid; under domestic manufactures $77.50 was awarded and paid; under agricultural implements $8 was awarded and paid; under youth's department $18.55 was awarded and paid; under objects other than agricultural, not specified, $37 was awarded and paid; under trotting $24 was paid. The society reports 606 members, — 582 males and 24 females. Three farmers' institutes were held: at Chesterfield, January 8, on "Dairying;" at Ashfield, February 27, on "Corn culture" and "The silo and ensilage;" and at Cummington, September 24, when the public winter meeting of the Board of Agriculture was discussed, and present methods of agriculture compared with those of fifty years ago.

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* Of this amount $24 was for trotting premiums.

HINGHAM AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 99.

Originally raised by contribution $17,406.15; now has $22,000 invested as a capital stock in real estate and personal property. Total assets, $22,160.82: real estate, $20,000; crockery, tables, etc., $2,000; cash on hand, $160.82. Receipts in 1895, $2,831.77: bounty, $600; new members, $58; donations, $119.65; other sources, $2,054.12. Expenditures in 1895, $2,601.18: premiums and gratuities paid, $716.75; current running expenses, $1,861.21; interest, $23.22. The society offered in premiums $1,950.10 and awarded and paid $716.75 in premiums and gratuities, which went to 17 cities and towns. Two hundred and five persons received premiums and 406 gratuities. Under head of farms $10 was awarded and paid; under farm and pet stock $322.75 was awarded and paid; under farm and garden products $247.40 was awarded and paid; under dairy products $3 was awarded and paid; under domestic manufactures $79.45 was awarded and paid; under objects other than agricultural, not specified, $54.15 was awarded and paid. The society reports 702 members, — 496 males and 206 females. Four farmers' institutes were held at Hingham: June 3, on "Petticoat gardening;" August 5, on "Agricultural progress;" October 28, on "Cause of low prices of farm products" and "Cranberry and celery culture;" and December 2, on "Waste in farming; how shall it be prevented?"

HOOSAC VALLEY AGRICULTURAL SOCIETY.

Incorporated 1860, Acts of 1860, chapter 56.

Originally raised by contribution $2,006; now has $16,000 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $16,296.85: real estate, $15,500; crockery, tables, etc., $500; bills due and unpaid, $36; cash on hand, $260.85. Total liabilities consist of a bank note for $3,300. Receipts in 1895, $5,816.44: bounty, $600; new members, $175; donations, $115.14; other sources,

$4,926.30. Expenditures in 1895, $5,816.44: premiums paid, $2,836.88; current running expenses, $2,070.89; interest, $154.93; improvements, $753.74. The society offered in premiums $3,675 and awarded and paid $2,836.88,* which went to 18 cities and towns. One hundred and thirty-three dollars and seventy-five cents went to 5 cities and towns outside the State. One hundred and ninety-eight persons received premiums. Under head of farms $18 was awarded and paid; under farm and pet stock $456.50 was awarded and paid; under field and garden crops $154 was awarded and paid; under farm and garden products $149.50 was awarded and paid; under dairy products $27 was awarded and paid; under domestic manufactures $221 was awarded and paid; under agricultural implements $20 was awarded and paid; under objects other than agricultural, not specified, $117.50 was awarded and paid; under trotting $1,515 was paid. The society reports 974 members, — 958 males and 16 females. Three farmers' institutes were held: at Williamstown, February 20, on "Market gardening" and "The production and sale of milk and butter;" at Adams, April 5, on "The cost of a quart of milk;" and at Williamstown, December 17, on "Care and composition of milk."

HOUSATONIC AGRICULTURAL SOCIETY.

Incorporated 1848, Acts of 1848, chapter 101.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $6,335.33; now has $17,070.88 invested as a capital stock in real estate, stocks, bank funds, crockery, tables, etc. Total assets, $17,456.69: real estate, $15,000; stocks, $1,000; bank funds, $920.88; crockery, tables, etc., $150; bills due and unpaid, $120.25; cash on hand, $265.56. Total liabilities, $2,300: outstanding bills, $250; note and interest, $2,050. Receipts in 1895, $11,330.75: bounty, $600; stocks, $51.25; bank funds, $33.48; new members, $224.67; other sources, $10,431.35. Expenditures in 1895, $10,990.46: premiums paid, $2,878.59; current running expenses, $3,517.76; interest, $87.22; other expenses, $4,506.89. The society offered in premiums $2,431; awarded in premiums, etc., $2,896.09 and paid $2,878.59, which went to 17 cities and towns. Seven hundred and thirty-two dollars and fifty cents went to 3 cities and towns outside the State in trotting purses. Four hundred and twenty-one persons received premiums. Under head of farm and pet stock $924 was awarded and $917 paid; under field and garden crops $273 was awarded and $269 paid; under farm and garden products $281 was awarded and paid; under dairy products $36 was awarded and paid; under domestic manufactures $429.15 was awarded and $422.65 paid; under objects other than agricultural, including sports, $853.84 was awarded and paid; $1,540 was paid for trotting. The society reports 1,607 members, — 1,555 males and 52 females. Three farmers' institutes were held: at Great Barrington, February 12, on "Tuberculosis in cattle;" at Lee, March 12, on "The cost of a quart of milk," "The relative proportion of nutrients" and "The value of feeds;" and at Great Barrington, November 26, on "The management of a dairy farm."

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* Of this amount $1,515 was for trotting premiums.

MARSHFIELD AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 116.

Originally raised by contribution $3,755.43; now has $27,980.08 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $28,022.24: real estate, $26,472.78; crockery, tables, etc., $1,507.30; cash on hand, $42.16. Total liabilities, $5,969.25: premiums due and unpaid, $279.25; outstanding bills, $120; mortgages or like liabilities, $5,570. Receipts in 1895, $3,176.51: bounty, $600; new members, $35; other sources, $2,541.51. Expenditures in 1895, $3,134.35: premiums and gratuities paid, $1,154.04; current running expenses, $1,406.39; interest, $373.92; other expenses, $200. The society offered in premiums $1,598.50, awarded in premiums and gratuities $1,433.29 * and paid $1,154.04,* which went to 31 cities and towns. Six dollars and five cents went to 3 cities and towns outside the State. Eighty persons received premiums and 300 gratuities. Under head of farm and pet stock $219.62 was awarded and $214.62 paid; under field and garden crops $7.25 was awarded and paid; under farm and garden products $197.20 was awarded and $158.65 paid; under dairy products $9 was awarded and paid; under domestic manufactures $115.47 was awarded and $115.27 paid; under objects other than agricultural, not specified, $25.25 was awarded and paid; $779.50 was paid for trotting. The society reports 879 members, — 570 males and 309 females. Three farmers' institutes were held at Marshfield: January 3, on "The production of milk for profit," "Market gardening" and "The raising of fruit for profit;" February 22, on "Crops," "The gullibility of farmers" and "The grange;" and March 20, on "Capital and labor on the farm," "Salt hay; its composition and uses," "Reminiscences of the West" and "Market gardening."

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* Of these amounts $779.50 was for trotting.

MARTHA'S VINEYARD AGRICULTURAL SOCIETY.

Incorporated 1859, Acts of 1859, chapter 33.

Originally raised by contribution $4,552.17; now has $4,246.66 invested as a capital stock in real estate, notes, bank funds, crockery, tables, etc. Total assets, $4,374.89: real estate, $2,750; notes, $500; bank funds, $796.66; crockery, tables, etc., $200; bills due and unpaid, $11.50; cash on hand, $116.73. Liabilities amount to $18 in premiums due and unpaid. Receipts in 1895, $1,263.91: bounty, $600; notes, $30; bank funds, $27.62; new members, $34; other sources, $572.29. Expenditures in 1895, $1,187.69: premiums and gratuities paid, $665.27; current running expenses, $257.38; other expenses, $265.04. The society offered $728.50 in premiums, awarded $683.27 in premiums and gratuities and paid $665.27, which went to 6 towns. Fifty-six persons received premiums and 155 gratuities. Under head of farms $6 was awarded and paid; under farm and pet stock $239.25 was awarded and paid; under field and garden crops $80.25 was awarded and $70.25

paid; under farm and garden products $149.64 was awarded and paid; under dairy products $14 was awarded and paid; under domestic manufactures $137.18 was awarded and paid; under objects other than agricultural, not specified, $30.85 was awarded and $22.85 paid; $26.10 was paid for trotting. The society reports 195 members, — 117 males and 78 females. Three farmers' institutes were held at West Tisbury: August 31, on "Are horse races of advantage to agricultural societies?" September 26, on "What can be done to make our agricultural society more useful?" and December 17, on "Would a creamery on Martha's Vineyard be likely to prove a commercial success?"

MASSACHUSETTS HORTICULTURAL SOCIETY.

Incorporated 1829, Acts of 1829, chapter 22.

The first investment was from surplus, Jan. 16, 1835, and amounted to $525. The society now has $247,000 invested as a capital stock in real estate, library, bonds and furniture. Total assets, $333,898.97: real estate, $250,000; notes, $304.85; loan, $5,000; bonds, $27,352.50; bank funds, $4,998.26; crockery, tables, etc., $42,058.53; bills due and unpaid, $1,687.74; cash on hand, $2,497.09. Total liabilities, $9,350: premiums due and unpaid, $8,350; mortgages or like liabilities, $1,000. Receipts in 1895, $30,009.82: bounty, $600; bonds, $1,237.50; bank funds, $74.68; new members and assessments, $1,348; donations, $20; other sources, $26,729.64. Expenditures in 1895, $24,253.71: premiums and gratuities paid, $7,644.60; current running expenses, $15,957.23; interest, $101.88; other expenses, $550. The society offered in premiums $7,900,* awarded in premiums and gratuities $7,712.60* and paid $7,644.60,* which went to 74 cities and towns. One hundred and ninety-five dollars went to 8 cities and towns outside the State. Two hundred and five† persons received premiums and 135† gratuities. Under head of farms $532 was awarded and $570 paid; under farm and garden products $7,444.25 was awarded and $7,181.60 paid.

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* Offered and awarded in 1894; paid in 1895. † Not including school gardeners.

The society reports 785 members, — 729 males and 56 females. Thirteen farmers' institutes were held at Horticultural Hall, Boston: January 5, the annual address by the president; January 12, "Bird talk;" January 19, "Flower pots and their manufacture;" January 26, "The fungous diseases of ornamental plants;" February 2, "Hardy plants and shrubs preferred for ornamental gardening;" February 9, "The construction of glass houses;" February 16, "Economic entomology;" February 23, "Experimental evolution amongst plants;" March 2, "Gardens and gardening;" March 9, "Budding and grafting;" March 16, "Some notes on tomatoes;" March 23, "Edible native fungi;" and March 30, "How commercial fertilizers can be applied to horticulture."

MASSACHUSETTS SOCIETY FOR PROMOTING AGRICULTURE.

Incorporated 1792, Acts of 1792, chapter 33.

This society made no returns to the Board of Agriculture for the year 1895.

MIDDLESEX NORTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 315.

Originally raised by contribution $3,000; now has $35,000 invested as a capital stock in real estate. Total assets, $35,938.22: real estate, $35,000; crockery, tables, etc., $375; bills due and unpaid, $56; cash on hand, $507.22. Total liabilities, $7,861.50: premiums due and unpaid, $136.50; outstanding bills, $125; mortgages or like liabilities, $7,600. Receipts in 1895, $8,055.90: bounty, $600; new members, $26; other sources, $7,429.90. Expenditures in 1895, $7,046.41: premiums and gratuities paid, $704.50; current running expenses, $1,640.25; interest, $150; other expenses, $4,551.66. The society offered in premiums $1,230.70, awarded in premiums and gratuities $841 and paid $704.50, which went to 11 cities and towns. One hundred and fifty-six persons received premiums and 42 gratuities. Under head of farm and pet stock

$403.50 was awarded; under field and garden crops $74.50 was awarded; under farm and garden products $247.50 was awarded; under domestic manufactures $118.50 was awarded; under agricultural implements $16 was awarded; $992.25 was paid for trotting and other attractions. The society reports a membership of 925 males. Four farmers' institutes were held: at Lowell, January 23, on "Tuberculosis;" at Bedford, January 30, on "Manures and fertilizers, and their uses;" at Tewksbury, February 20, on "Plant food: what it is and where it comes from;" and at North Reading, March 20, on "Farming as a business."

MIDDLESEX SOUTH AGRICULTURAL SOCIETY.

Incorporated 1854, Acts of 1854, chapter 84.

Originally raised by contribution $3,000; now has $13,000 invested as a capital stock in real estate. Total assets, $13,275.62: real estate, $13,000; crockery, tables, etc., $200; cash on hand, $75.62. Total liabilities, $7,750: notes, $1,250; mortgages, $6,500. Receipts in 1895, $3,168.96: bounty, $577.40; amount borrowed, $1,250; new members, $116.93; donations, $97.70; other sources, $1,126.93. Expenditures in 1895, $3,093.71: premiums and gratuities paid, $628.05; current running expenses, $564.10; interest, $378.07; other expenses, $1,523.49. The society offered in premiums $1,186.55 and awarded and paid $628.05, which went to 9 towns. One hundred and ten persons received premiums and 56 gratuities. Under head of farms $36 was awarded and paid; under farm and pet stock $311.50 was awarded and paid; under field and garden crops $88 was awarded and paid; under farm and garden products $119.15 was awarded and paid; under domestic manufactures $59.45 was awarded and paid; under objects other than agricultural, not specified, $13.95 was awarded and paid; $425 was paid for trotting. Diplomas were awarded for agricultural implements. The society reports 560 members, — 366 males and 194 females. Four farmers' institutes were held: at Framingham, January 16, on "Poultry raising and how to make it profitable;" at Sherborn, February 15 and March 1, on "Tuberculosis;" and at Hudson, March 13, on "Fruit culture," "Holstein cattle" and "Moonshine in farming."

NANTUCKET AGRICULTURAL SOCIETY.

Incorporated 1856, Acts of 1856, chapter 25.

Originally raised by contribution $3,500; now has $3,200 invested as a capital stock in real estate. Total assets, $3,292.92: real estate, $3,200; bills due and unpaid, $92.92. Total liabilities consist of outstanding bills to the amount of $92.92. Receipts in 1895, $1,246.97: bounty, $600; new members, $20; all other sources, $626.97. Expenditures in 1895, $1,349.89: premiums and gratuities paid, $587.25;* current running expenses, $762.64. The society offered in premiums $1,179.50 and awarded and paid in premiums and gratuities $587.25,* which went to 1 town. One hundred and twenty-eight persons received premiums and 80 gratuities. Under head of farms $20 was awarded and paid; under farm and pet stock $301.50 was awarded and paid; under field and garden crops $24.75 was awarded and paid; under farm and garden products $84 was awarded and paid; under dairy products $3 was awarded and paid; under domestic manufactures $85 was awarded and paid; under trotting $45 was paid; under objects other than agricultural, not specified, $74 was awarded and $24 paid. The society reports 533 members, — 211 males and 322 females. Three farmers' institutes were held at Nantucket: October 21, on "Improvement of agricultural societies;" November 11, on "Farming as a business;" and November 12, on "Poultry culture."

OXFORD AGRICULTURAL SOCIETY.

Incorporated 1888, Acts of 1888, chapter 93.

Originally raised by contribution $4,400; now has $7,917.09 invested as a capital stock in real estate, cash on hand, crockery, tables, etc. Total assets, $7,917.09:

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* Of this amount $45 was for trotting.

real estate, $7,500; crockery, tables, etc., $200; cash on hand, $217.09. Total liabilities consist of mortgages or like liabilities to the amount of $500. Receipts in 1895, $2,674.39: bounty, $600; new members, $48; donations, $27.25; other sources, $1,999.14. Expenditures in 1895, $2,457,30: premiums paid, $1,100.40; current running expenses, $500; interest, $12.50; other expenses, $844.40. The society offered in premiums $1,700, awarded $1,121.25* and paid $1,100.40,* which went to 13 cities and towns. One hundred and twenty-seven persons received premiums. Under head of farms $48 was awarded and paid; under farm and pet stock $561.50 was awarded and $549.88 paid; under field and garden crops $44.25 was awarded and $42.25 paid; under farm and garden products $17.50 was awarded and $16.20 paid; under dairy products $9 was awarded and $8 paid; under domestic manufactures $39.75 was awarded and $36.38 paid; under agricultural implements $4 was awarded and paid; under objects other than agricultural, not specified, $17.25 was awarded and $15.69 paid; $380 was paid for trotting. The society reports 642 members, — 345 males and 297 females. Three farmers' institutes were held: at Dudley, January 18, on "Tuberculosis;" at Oxford, February 27, on "The demands of the future upon the New England farmer;" and at Auburn, December 4, on "How can farmers most profitably employ their dairies" and "Tuberculosis."

PLYMOUTH COUNTY AGRICULTURAL SOCIETY.

Incorporated as the Agricultural Society in the county of Plymouth, 1819, Acts of 1819, chapter 2; name changed to Plymouth County Agricultural Society in 1870, Acts of 1870, chapter 251.

The society in its first report to the Board in 1853 stated the amount of its permanent fund (par value) to be $9,550; now has $35,200 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $35,310: real estate, $35,000; crockery, tables, etc., $200; cash on hand, $110. Liabilities consist of notes to the amount of $4,600. Receipts in 1895, $4,965.83: bounty, $600; new members,

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* Of these amounts $380 was for trotting premiums.

$13; donations, $76.85; other sources, $4,275.98. Expenditures in 1895, $5,606.17: premiums and gratuities paid, $2,838.95; current running expenses, $2,486; interest, $227.65; other expenses, $53.57. The society offered in premiums $3,937.50 and awarded and paid in premiums and gratuities $2,838.95,* which went to 27 cities and towns. Three hundred and thirty-four persons received premiums and 42 gratuities. Under head of farms $34 was awarded and paid; under farm and pet stock $835.50 was awarded and paid; under field and garden crops $33 was awarded and paid; under farm and garden products $209.25 was awarded and paid; under dairy products $27 was awarded and paid; under domestic manufactures $165.70 was awarded and paid; under objects strictly agricultural, not specified, $45 was awarded and paid; under objects other than agricultural, not specified, $67 was awarded and paid; $1,422.50 was paid for trotting. The society reports 1,548 members, — 907 males and 641 females. Three farmers' institutes were held: at West Bridgewater, January 18, on "The management of milch cows;" at Middleborough, February 22, on "The management of a dairy farm;" and at Bridgewater, December 17, on "Truck farming."

SPENCER FARMERS' AND MECHANICS' ASSOCIATION.

Incorporated 1888, Acts of 1888, chapter 87.

Originally raised by contribution $4,034.08; now has $7,950 invested as a capital stock in real estate, crockery, tables, etc. Total assets, $8,336.10: real estate, $7,150; crockery, tables, etc., $800; cash on hand, $386.10. Liabilities consist of mortgages or like liabilities to the amount of $1,500. Receipts in 1895, $3,473.36: bounty, $600; new members, $39; donations, $500; other sources, $2,334.36. Expenditures in 1895, $3,087.26: premiums and gratuities paid, $1,875.10; current running expenses, $1,000.56; interest, $67.50; other expenses, $144.10. The society offered in premiums $2,500, awarded in premiums and gratuities $1,931.10* and paid $1,875.10,* which went to 21 cities and towns. One dollar and thirteen cents went to 1 city outside the State. One hundred and fifty-two persons received premiums and 13 gratuities. Under head of farms $60 was awarded and paid; under farm and pet stock $869 was awarded and $860 paid; under field and garden crops $38 was awarded and $30.50 paid; under farm and garden products $81.25 was awarded and $75.25 paid; under dairy products $9 was awarded and paid; under domestic manufactures $69.75 was awarded and $61 paid; $780 was paid for trotting. The society reports 915 members, — 493 males and 422 females. Three farmers' institutes were held: at Spencer, January 18, an all-day dairy institute with the Babcock tester; at Oakham, January 25, on "Manures and fertilizers and their use;" and at Brookfield, March 14, on "Market gardening in connection with dairying" and "The relation of botany to agriculture."

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* Of this amount $1,422.50 was for trotting purses.

UNION AGRICULTURAL AND HORTICULTURAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 110.

Originally raised by contribution $4,447.23; now has $9,000 invested as a capital stock in real and personal estate. Total assets, $9,453.64: real estate, $8,000; crockery, tables, etc., $1,000; cash on hand, $453.64. Total liabilities, $2,216.08: premiums due and unpaid, $66.08; mortgages or like liabilities, $2,150. Receipts in 1895, $2,619.31: bounty, $600; new members, $55; other sources, $1,964.31. Expenditures in 1895, $2,165.67: premiums and gratuities paid, $1,186.67; current running expenses, $828.23; interest, $108.65; 1894 premiums paid, $42.12. The society offered in premiums $1,829.05, awarded in premiums and gratuities $1,252.75† and paid $1,186.67,† which went to 24 cities and towns. Five dollars and twenty-four cents went to parties outside the State. Two hundred and nine persons received premiums and 94 gratuities.

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* Of these amounts $780 was for trotting premiums.

† Of these amounts $415 was for trotting premiums.

Under head of farm and pet stock $494.75 was awarded and $467.50 paid; under field and garden crops $48.50 was awarded and paid; under farm and garden products $46.15 was awarded and $43.69 paid; under dairy products $13.50 was awarded and paid; under domestic manufactures $85.55 was awarded and $80.54 paid; under agricultural implements $5.25 was awarded; under objects strictly agricultural, not specified, $82 was awarded and paid; under objects other than agricultural, not specified, $62.05 was awarded and $35.94 paid; $415 was paid for trotting. The society reports 1,258 members, — 584 males and 674 females. Three farmers' institutes were held at Blandford: January 24, on "Co-operation among farmers;" February 15, on "Composition of milk;" and April 11, on "Balanced rations for butter and milk."

WEYMOUTH AGRICULTURAL AND INDUSTRIAL SOCIETY.

Incorporated 1891, Acts of 1891, chapter 77.

Amount originally raised by contribution had increased in 1891 to $10,270, invested as a capital stock in real estate, crockery, tables, etc. Total assets, $10,325.15: real estate, $10,000; crockery, tables, etc., $270; bills due and unpaid, $50; cash on hand, $5.15. Liabilities consist of mortgages or like liabilities to the amount of $2,000. Receipts in 1895, $4,474.62: bounty, $600; other sources, $3,874.62. Expenditures in 1895, $4,568.15: premiums and gratuities paid, $667; current running expenses, $2,383.40; interest, $117.75; notes paid, $1,400. The society awarded in premiums and gratuities $998 and paid $667, which went to 18 cities and towns. Three hundred and twenty persons received premiums and gratuities. Under head of farm and pet stock $406.35 was awarded and $378.35 paid; under farm and garden products $155.15 was awarded and $148 paid; under dairy products $1.50 was awarded and paid; under domestic manufactures $114.25 was awarded and $94.50 paid; under objects strictly agricultural, not specified, $35.75 was awarded and $34.25 paid; $727.50 was paid for trotting. The society reports 427 members, — 415 males and 12 females. Three farmers' institutes were held at South Weymouth: March 1, on "Tuberculosis;" March 14, on "General fruit culture;" and April 4, on "Commercial and other fertilizers."

WORCESTER AGRICULTURAL SOCIETY.

Incorporated 1818, Acts of 1818, chapter 168.

The society in its first report to the Board in 1853 stated that the amount of its permanent fund (par value) was $7,730; now has $140,000 invested as a capital stock in real estate. Total assets, $141,239.63: real estate, $140,000; bank funds, $39.61; crockery, tables, etc., $600; bills due and unpaid, $600.02. Total liabilities, $54,025.31: outstanding bills, $275.31; mortgages or like liabilities, $53,750. Receipts in 1895, $25,763.64: bounty, $600; bank funds, $18.67; new members, $205; donations, $2,162.13; other sources, $22,777.84. Expenditures in 1895, $25,724.03: premiums paid, $10,965.21; current running expenses, $9,327.20; other expenses, $5,431.62. The society offered in premiums $14,617.25 and awarded and paid $10,965.21,* which went to 97 cities and towns. Two thousand three hundred two dollars and forty-one cents went to 29 cities and towns outside the State. Three hundred and thirty-four persons received premiums. Under head of farms $118 was awarded and paid; under farm and pet stock $4,406 was awarded and paid; under farm and garden products $832.50 was awarded and paid; under dairy products $189.46 was awarded and paid; under domestic manufactures $146.75 was awarded and paid; under grange exhibits $140 was awarded and paid; under objects other than agricultural, not specified, $97.50 was awarded and paid; $5,035 was paid for trotting. The society reports 1,987 members, — 1,830 males and 157 females. Three farmers' institutes were held: at Holden, January 11, on "The management of a dairy farm" and "Tuberculosis and the State Cattle Commission;" at Shrewsbury, February

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* Of this amount $5,035 was for trotting purses.

12, on "Market gardening in connection with dairying" and "The composition of milk; its food value;" and at Grafton, March 15, on "Fruit culture in Massachusetts" and "Profitable poultry culture."

WORCESTER EAST AGRICULTURAL SOCIETY.

Incorporated 1890, Acts of 1890, chapter 41.

Originally raised by contribution $1,015; now has $4,061.03 invested as a capital stock in real estate, bank funds, cash, crockery, tables, etc. Total assets, $4,061.03: real estate, $3,410; bank funds, $426.03; crockery, tables, etc., $225. Liabilities are estimated to be $75 in outstanding bills. Receipts in 1895, $3,872.68: bounty, $600; bank funds, $18.02; new members, $96; donations, $143; other sources, $3,015.66. Expenditures in 1895, $4,072.71: premiums and gratuities paid, $1,549.25; current running expenses, $2,523.46. The society offered in premiums $1,600, awarded in premiums and gratuities $1,575.50 and paid $1,549.25, which went to 21 cities and towns. Seven dollars and fifty cents went to 1 town outside the State. Two hundred and nineteen persons received premiums and gratuities. Under head of farms $22 was awarded and paid; under farm and pet stock $895.20 was awarded and paid; under farm and garden products $239.50 was awarded and paid; under dairy products $77 was awarded and paid; under domestic manufactures $70.75 was awarded and paid; under objects strictly agricultural, not specified, $89 was awarded and paid; under committee reports $20 was awarded; under grange exhibits $160 was awarded and paid; $297.50 was paid for trotting. The society reports 685 members, — 464 males and 221 females. Three farmers' institutes were held: at Clinton, January 10, on "Tuberculosis and tuberculin;" at Clinton, January 31, on "The business side of fertilizers;" and at Lancaster, February 20, on "The cultivation of small fruits."

WORCESTER NORTH AGRICULTURAL SOCIETY.

Incorporated as the Fitchburg Agricultural Society, 1852, Acts of 1852, chapter 79; name changed to Worcester North Agricultural Society, 1853, Acts of 1853, chapter 359.

Originally raised by contribution $2,128; now has $2,806.05 invested as a capital stock in real estate, fixtures and cash. Total assets, $2,806.05: real estate, $2,500; crockery, tables, etc., $300; cash on hand, $6.05. Receipts in 1895, $2,043.15: bounty, $600; bank funds, $52.40; donations, $24; other sources, $1,366.75. Expenditures in 1895, $3,137.57: premiums and gratuities paid, $994.25; current running expenses, $2,143.32. The society offered no fixed sum in premiums, awarded in premiums and gratuities $1,012.25 and paid $994.25, which went to 11 cities and towns. One hundred and sixty-eight persons received premiums and 20 gratuities. Under head of farms $24 was awarded and paid; under farm and pet stock $498 was awarded and paid; under field and garden crops $58.50 was awarded and paid; under farm and garden products $208.60 was awarded and paid; under dairy products $8 was awarded and paid; under domestic manufactures $35.50 was awarded and $37.75 paid; under objects other than agricultural, not specified, $45 was awarded and paid; $385 was paid for trotting. The society reports 795 members, — 734 males and 61 females. Six farmers' institutes were held: at Lunenburg, January 11, on "Sanitary condition of country homes" and "An hour with the weather man;" at Ashburnham, January 24, on "The dairy cow;" at Westminster, February 1, on "Tuberculosis" and "Cattle breeding;" at North Leominster, February 12, on "Small fruits for family use" and "Spraying for insects and fungi;" at Ashby, February 14, on "The farms and farmers of Japan;" and at Townsend, February 22, on "Fertilizers" and "The farmer as a citizen."

WORCESTER NORTHWEST AGRICULTURAL AND MECHANICAL SOCIETY.

Incorporated 1867, Acts of 1867, chapter 117.

Originally raised by contribution $3,400; now has $10,803.88 invested as a capital stock in real estate, cash, crockery, tables, etc. Total assets, $12,803.88: real estate, $11,000; crockery, tables, etc., $400; cash on hand, $1,403.88. Liabilities consist of mortgages or like liabilities to the amount of $2,000. Receipts in 1895, $6,496.74: bounty, $600; new members, $365; other sources, $5,531.74. Expenditures in 1895, $5,694.10: premiums paid, $2,618.94; current running expenses, $2,955.16; interest, $120. The society offered in premiums $3,371, awarded $2,652.20 and paid $2,618.94,* which went to 36 cities and towns. Five hundred and seventy-eight dollars and forty-two cents went to 6 cities and towns outside the State. One hundred and eighty-three persons received premiums. Under head of farms $29 was awarded and paid; under farm and pet stock $779.50 was awarded and $766.50 paid; under farm and garden products $159.50 was awarded and $155.92 paid; under dairy products $19 was awarded and paid; under domestic manufactures $53.70 was awarded and $47.19 paid; under agricultural implements $12 was awarded and paid; under objects other than agricultural, not specified, $52.50 was awarded and $42.33 paid; $1,547 was paid for trotting. The society reports 996 members, — 654 males and 342 females. Four farmers' institutes were held: at Templeton, January 29, on "Tuberculosis;" at North Orange, February 8, on "Grasses and forage crops;" at Gardner, February 27, on "Growing and feeding forage crops for market" and "Profitable breeding of dairy cows;" and at Athol, March 8, on "The management of milch cows" and "An hour with the weather man."

WORCESTER SOUTH AGRICULTURAL SOCIETY.

Incorporated 1855, Acts of 1855, chapter 278.

Originally raised by contribution $3,127.40; now has $8,500 invested as a capital stock in real estate and personal property. Total assets, $8,695.06: real estate, $8,000; crockery, tables, etc., $500; cash on hand, $195.06. Total liabilities amount to $973.25. Receipts in 1895, $3,653.50: bounty, $600; new members, $67; other sources, $2,986.50. Expenditures in 1895, $3,580.56: premiums and gratuities paid, $1,728.50; current running expenses, $1,430.26; other expenses, $421.80. The society offered in premiums $2,424.50, awarded in premiums and gratuities $1,791.75 and paid $1,728.50,* which went to 22 cities and towns. One hundred and twelve persons received premiums and 63 gratuities. Under head of farms $89 was awarded and $54 paid; under farm and pet stock $768 was awarded and paid; under farm and garden products $138 was awarded and $123.25 paid; under dairy products $29 was awarded and paid; under domestic manufactures $112.75 was awarded and $110.75 paid; under agricultural implements $10 was awarded and paid; under objects strictly agricultural, not specified, $50 was awarded and paid; under objects other than agricultural, not specified, $10 was awarded and paid; $600 was paid for trotting. The society reports 1,733 members, — 872 males and 861 females. Three farmers' institutes were held: at Sturbridge, January 18, on "Tuberculosis in cattle;" at Southbridge, February 20, on "The business side of fertilizing" and "Tuberculosis;" and at Brookfield, March 14, on "Market gardening in connection with dairying" and "The relation of botany to agriculture."

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* Of this amount $1,547 was for trotting.

WORCESTER COUNTY WEST AGRICULTURAL SOCIETY.

Incorporated 1851, Acts of 1851, chapter 278.

Originally raised by contribution $3,175; now has $13,600 invested as a capital stock in real estate and personal property. Total assets, $13,752.06: real estate, $12,600; crockery, tables, etc., $1,000; cash on hand, $152.06. Total liabilities consist of notes to the amount of $1,200. Receipts in 1895, $2,851.05: bounty, $600; new members, $35; donations, $25.25; other sources, $2,190.80. Expenditures in 1895, $2,723.78: premiums and gratuities paid, $1,528.60; current running expenses, $911.18; interest, $84; paid on note, $200. The society offered in premiums $1,798.25, awarded in premiums and gratuities $1,553.85 and paid $1,528.60,* which went to 36 cities and towns. Fifty dollars and seventy-five cents went to 3 cities and towns outside the State. One hundred and seventy-nine persons received premiums and 31 gratuities. Under head of farms $34 was awarded and $31.50 paid; under farm and pet stock $538.90 was awarded and $524.90 paid; under field and garden crops $25.85 was awarded and $24.75 paid; under farm and garden products $108.10 was awarded and $105.05 paid; under dairy products $12 was awarded and $9 paid; under domestic manufactures $62 was awarded and $60.40 paid; under objects other than agricultural, not specified, $102 was awarded and paid; $671 was paid for trotting. The society reports 528 members, — 474 males and 54 females. Three farmers' institutes were held: at Barre, January 4, on "Tuberculosis;" at Rutland, January 18, on "How to feed the dairy cow for milk and cream production; the skim-milk and how to use it, and tests with tester;" and at Petersham, February 15, on "Tuberculosis."

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* Of this amount $600 was for trotting purses.

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* Of this amount $671 was for trotting premiums.

Summary.

	1893.	1894.	1895.
Number of societies, ...	*38	†36	†35
Amount held invested or well secured as a capital stock, ...	$777,880 36	$776,486 22	$763,303 42
Assets of societies, ...	865,247 67	868,860 56	861,719 36
Liabilities of societies, ...	131,085 52	142,119 01	139,821 46
Receipts, ...	199,461 90	186,244 37	188,403 88
Expenditures, ...	193,930 58	187,582 34	179,094 89
Bounty received from the State, . . .	20,982 45	20,628 80	20,606 20
Current running expenses, ...	69,891 88	67,822 24	77,786 73
Amount of premiums offered, ...	81,022 73	81,096 42	85,838 53
Amount of premiums and gratuities awarded,	64,401 66	62,559 37	66,912 26
Amount of premiums and gratuities paid, . .	62,994 84	61,054 66	65,209 35
Amount awarded under head of farms, . .	1,425 00	1,477 50	1,391 00
Amount awarded under head of farm and pet stock, ...	20,905 40	22,024 70	22,158 47
Amount awarded under head of field and garden crops, ...	1,138 50	1,351 25	1,305 10
Amount awarded under head of farm and garden products, ...	12,824 50	13,369 47	13,483 29
Amount awarded under head of dairy products, ...	572 35	592 50	687 21
Amount awarded under head of domestic manufactures, ...	3,820 33	4,031 47	3,692 53
Amount awarded under head of miscellaneous, ...	3,451 70	3,031 59	3,138 52
Amount paid under head of trotting, . .	22,115 00	23,346 57	25,247 35
Number of persons receiving premiums, . .	8,103	7,921	7,247
Number of persons receiving gratuities, . .	1,597	1,908	2,872
Total male membership of the societies, . .	23,918	23,658	23,099
Total female membership of the societies, .	6,834	7,050	7,017
Total membership of the societies, . . .	30,752	30,708	30,116
Number of farmers' institutes held, . . .	135	125	118

* Three held no fair.

† One held no fair.

ANNUAL MEETING

OF THE

BOARD OF AGRICULTURE

AT BOSTON.

FEBRUARY 4, 5 AND 6, 1896.

ANNUAL MEETING.

The Board met at the office of the secretary, in Boston, on Tuesday, Feb. 4, 1896, at 12 M., it being the Tuesday preceding the first Wednesday in February. In the absence of the Governor the Board was called to order by the first vice-president, Hon. Jas. S. GRINNELL.

Present: Messrs. Alger, F. H. Appleton, J. S. Appleton, Jr., Avery, Barton, Blair, Bourne, Bursley, Clark, Cook, Cruickshanks, Damon, Goessmann, Gove, Grinnell, Hartshorn, Hersey, Horton, Kilbourn, Lyman, Norton, Palmer, Pratt, S. M. Raymond, Reed, Sargent, Sessions, N. W. Shaw, Stetson, Taylor, Ward, Wellington and Wood.

The records of the special meeting of the Board at Dalton were read and approved.

Adjourned to 2.30 P.M.

Board called to order by Mr. GRINNELL at 2.30 P.M.

The executive committee, by Mr. Wood, chairman, reported the list of qualified members of the Board for 1896. The newly elected members are as follows: —

At large, appointed by the Governor: —
  James S. GRINNELL of Greenfield.
Elected by the societies: —
  Bristol County, N. W. SHAW of North Raynham.
  Deerfield Valley, F. H. SMITH of Ashfield.
  Essex, FRANCIS H. APPLETON of Peabody.
  Highland, SAMUEL M. RAYMOND of Hinsdale.
  Hillside, C. K. BREWSTER of Worthington.
  Middlesex South, ISAAC DAMON of Wayland.
  Plymouth County, AUGUSTUS PRATT of North Middleborough.
  Worcester, J. LEWIS ELLSWORTH of Worcester.
  Worcester North, GEORGE CRUICKSHANKS of Fitchburg.
  Worcester County West, E. A. HARWOOD of North Brookfield.

Which report was accepted.

Voted, On motion of Mr. Hersey, that a committee of five be appointed to consider the subject of changing the time of holding the annual meeting. The Chair appointed Messrs. F. H. Appleton, Hersey, Taylor, Avery and Stetson as the committee.

The records of the executive committee acting for the Board were read by the secretary and approved, and the actions of the committee were adopted as the actions of the Board.

The committee on agricultural societies reported items of interest in the reports of inspectors of fairs, and the reports were accepted and adopted, and directed to be sent to the secretary of each agricultural society for publication in the local papers and in the annual reports of the societies.

Voted, That it is the sense of the Board that the reports of inspectors should be submitted to the committee on agricultural societies as soon as possible after they are received at the office of the Board, and that copies of the same be sent to the societies interested as soon as may be after the committee has examined said reports.

A statement was read showing the delinquencies of certain societies in making their financial and premium returns and in complying with the rules of the Board.

Voted, That the secretary be instructed to censure such delinquent societies, and inform them that in the future the laws and rules must be complied with.

The committee on forestry, by Mr. F. H. Appleton, chairman, reported that no special action had been taken during the year, which report was accepted.

The special committee on change of time of annual meeting reported that the executive committee be instructed to take measures to have the date of the annual meeting changed so as to have it come two weeks earlier. The report was accepted and adopted, and the executive committee so instructed.

The committee on domestic animals and sanitation reported that no action had been taken during the year, which report was accepted.

At 4.40 P.M. the Board adjourned to 10 A.M., Wednesday.

SECOND DAY.

The Board met at 9.30 A.M., Mr. GRINNELL in the chair.

Present: Messrs. F. H. Appleton, J. S. Appleton, Jr., Avery, Blair, Bourne, Brewster, Bursley, Clark, Cook, Cruickshanks, Damon, Ellsworth, Goessmann, Gove, Grinnell, Harwood, Hersey, Horton, Kilbourn, Lyman, Norton, Palmer, Pratt, S. M. Raymond, Reed, Sargent, Sessions, Francis Shaw, N. W. Shaw, Smith, Stetson, Taylor, Wellington and Wood.

The records of the first day were read and approved.

The report of the committee on Agricultural College and education was read by Mr. Geo. Cruickshanks, and was, by vote of the Board, accepted and adopted as the report of the Board to the Legislature, and will be found printed in this volume.

Voted, On motion of Mr. N. W. Shaw, that there be printed pamphlet copies of the report of the committee on Agricultural College and education, to be distributed under the direction of the executive committee.

Voted, That the secretary be directed to print and distribute among the members of the Board the schedule of the duties of inspectors adopted at the annual meeting in 1895, together with any amendments to duties made since.

Election of officers being in order, ballots were taken, and the election resulted as follows: —

President, His Excellency the Governor, *ex officio*.
First vice-president, JAMES S. GRINNELL of Greenfield.
Second vice-president, FRANCIS H. APPLETON of Peabody.
Secretary, WILLIAM R. SESSIONS of Hampden.

Election of specialists being in order, ballots were taken, and the election resulted as follows: —

Chemist, Dr. C. A. Goessmann of Amherst.
Entomologist, Prof. C. H. Fernald of Amherst.
Botanist and pomologist, Prof. S. T. Maynard of Amherst.
Veterinarian, Prof. James B. Paige of Amherst.
Engineer, Wm. Wheeler of Concord.
Ornithologist, E. H. Forbush of Malden.

The chairman announced the following standing committees (the secretary is by rule of the Board a member *ex officio* of each of the standing committees): —

Executive committee: Messrs. E. W. Wood of West Newton, W. A. Kilbourn of South Lancaster, Isaac Damon of Wayland, D. A. Horton of Northampton, A. C. Varnum of Lowell, Wm. P. Brooks of Amherst and Francis H. Appleton of Peabody.

Committee on agricultural societies: Messrs. W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, N. W. Shaw of North Raynham, F. E. Clark of Wilbraham and W. H. Gove of Blackinton.

Committee on domestic animals and sanitation: Messrs. Isaac Damon of Wayland, W. M. Tucker of Monson, G. E. Taylor of Shelburne, Francis Shaw of Wayland and F. H. Smith of Ashfield.

Committee on gypsy moth, insects and birds: Messrs. E. W. Wood of West Newton, Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury, S. S. Stetson of Lakeville and J. G. Avery of Spencer.

Committee on Dairy Bureau and agricultural products: Messrs. D. A. Horton of Northampton, Geo. L. Clemence of Southbridge, J. Lewis Ellsworth of Worcester, F. A. Palmer of Stockbridge and C. B. Lyman of Southampton.

Committee on Agricultural College and education: Messrs. A. C. Varnum of Lowell, Geo. Cruickshanks of Fitchburg, E. A. Harwood of North Brookfield, John Bursley of West Barnstable and C. K. Brewster of Worthington.

Committee on experiments and station work: Messrs. Wm. P. Brooks of Amherst, Edmund Hersey of Hingham, H. A. Cook of Northbridge, C. M. Blair of Blandford and W. M. Wellington of Oxford.

Committee on forestry, roads and roadside improvements: Messrs. Francis H. Appleton of Peabody, J. H. Bourne of Marshfield, S. M. Raymond of Hinsdale, J. S. Appleton, Jr., of Nantucket and H. G. Norton of West Tisbury.

Which appointments were approved by the Board.

At 12.30 P.M. the Board adjourned to 2.30 P.M.

The Board was called to order at 2.30 P.M., Mr. GRINNELL in the chair.

The committee on experiments and station work, by Mr. Clemence, reported in writing, which report was accepted, adopted and placed on file.

Mr. F. E. Clark presented a preamble and resolution relating to the subject of taxation, which, after discussion, was referred to a committee of three, to consider the same and report to the Board. The Chair appointed Messrs. F. H. Appleton, S. M. Raymond and F. E. Clark as the committee.

Prof. Wm. P. Brooks read an essay on "Field Crops," which was accepted and will be found printed in this volume.

Mr. F. H. Appleton, for the committee to whom was referred the preamble and resolution on taxation, presented by Mr. Clark, reported the following, which was unanimously adopted: —

Whereas, We believe that no legislation should be passed which shall place more burdens by taxation upon the farms of the State, to the detriment of our agriculture; and

Whereas, It is represented that efforts are being made to change the existing laws of taxation, so that they are likely to be detrimental to agricultural interests, —

We, the State Board of Agriculture, in annual session assembled, and having the interests of the State's agriculture in our charge, urge upon our Senators and Representatives, in Legislature assembled, to guard such interests, and prevent any unfair and unjust burdens being placed upon the farms and productive industries of the State; and we request our secretary to present these expressions to the General Court of 1896.

The committee on Agricultural College and education, by Mr. Cruickshanks, presented the report of the committee on place for public winter meeting, that the meeting should be held at Greenfield. The report was accepted, and the Board voted to hold the next winter meeting at Greenfield.

At 5 P.M. the Board adjourned to 9.30 A.M., Thursday.

THIRD DAY.

The Board met at 9.30 A.M., Mr. GRINNELL in the chair.

Present: Messrs. F. H. Appleton, J. S. Appleton, Jr., Avery, Blair, Bourne, Brewster, Bursley, Clark, Cook, Cruickshanks, Damon, Ellsworth, Goessmann, Gove, Grinnell, Hersey, Horton, Kilbourn, Lyman, Norton, Pratt, S. M. Raymond, Reed, Sargent, Sessions, Francis Shaw, N. W. Shaw, Smith, Stetson, Taylor, Wellington and Wood.

The records of the second day were read and approved.

Voted, On motion of Mr. Wood, that a local committee of seven, of whom the first vice-president shall be a member, be appointed by the Chair to act with the secretary in arranging for the public winter meeting. The Chair appointed Messrs. Taylor, Horton, Lyman, Brooks, Gove and Smith.

The committee on Agricultural College and education reported subjects and names of essayists for the next annual meeting, as follows: —

"Cold storage for farm products," Geo. L. Clemence; "The farmer's opportunity," C. B. Lyman.

The report was accepted and the appointments were made.

The committee on agricultural societies, by Mr. Kilbourn, chairman, reported recommending that the time of holding the fair of the Bristol County Agricultural Society be changed from the fourth Tuesday after the first Monday in September to the third Tuesday after the first Monday in

September; that the time of holding the fair of the Marshfield Agricultural and Horticultural Society be changed from the second Wednesday after the first Monday in September to the first Wednesday after the first Monday in September; that the time of holding the fair of the Plymouth County Agricultural Society be changed from the first Thursday after the first Monday in September to the second Wednesday after the first Monday in September; and that the time of holding the fair of the Weymouth Agricultural and Industrial Society be changed from the fourth Thursday after the first Monday in September to the third Thursday after the first Monday in September. The report was accepted and adopted.

The committee on agricultural societies, by Mr. Kilbourn, chairman, reported the following assignment of inspectors: —

Amesbury and Salisbury, at Amesbury, September 29, 30 and October 1,	C. M. Blair.
Barnstable County, at Barnstable, September 15, 16 and 17,	C. K. Brewster.
Berkshire, at Pittsfield, September 15, 16 and 17,	J. S. Grinnell.
Blackstone Valley, at Uxbridge, September 29 and 30,	S. S. Stetson.
Bristol County, at Taunton, September 22, 23 and 24,	F. E. Clark.
Deerfield Valley, at Charlemont, September 17 and 18,	C. B. Lyman.
Eastern Hampden, at Palmer, September 22 and 23,	J. H. Bourne.
Essex, at Peabody, September 22, 23 and 24,	N. W. Shaw.
Franklin County, at Greenfield, September 24 and 25,	Isaac Damon.
Hampden, at Westfield, September 24 and 25,	J. L. Ellsworth
Hampshire, at Amherst, September 29 and 30,	W. A. Kilbourn.
Hampshire, Franklin and Hampden, at Northampton, October 7 and 8,	Q. L. Reed.
Highland, at Middlefield, September 9 and 10,	H. A. Cook.
Hillside, at Cummington, September 29 and 30,	W. P. Brooks.
Hingham, at Hingham, September 29 and 30,	John Bursley.
Hoosac Valley, at North Adams, September 22, 23 and 24,	Geo. E. Taylor.
Housatonic, at Great Barrington, September 30, October 1 and 2,	J. G. Avery.

Marshfield, at Marshfield, September 9, 10 and 11,	D. A. Horton.
Martha's Vineyard, at West Tisbury, September 22 and 23,	G. L. Clemence.
Massachusetts Horticultural, at Boston, October 6, 7 and 8,	Geo. Cruickshanks.
Middlesex North, at Lowell, September 17, 18 and 19,	Edmund Hersey.
Middlesex South, at Framingham, September 15, 16 and 17,	W. M. Tucker.
Nantucket, at Nantucket, September 2 and 3,	W. H. Gove.
Oxford, at Oxford, September 22 and 23,	J. S. Appleton, Jr.
Plymouth County, at Bridgewater, September 16, 17 and 18,	F. W. Sargent.
Spencer, at Spencer, September 24 and 25,	Augustus Pratt.
Union, at Blandford, September 16, 17 and 18,	F. H. Appleton.
Weymouth, at South Weymouth, September 24, 25 and 26,	F. H. Smith.
Worcester, at Worcester, September 8, 9, 10 and 11,	S. M. Raymond.
Worcester East, at Lancaster, September 17 and 18,	Francis Shaw.
Worcester North, at Fitchburg, September 22 and 23,	H. G. Norton.
Worcester North-west, at Athol, October 6 and 7,	W. M. Wellington.
Worcester South, at Sturbridge, September 17 and 18,	F. A. Palmer.
Worcester County West, at Barre, October 1 and 2,	E. W. Wood.

The report was accepted and adopted.

Voted, On motion of Mr. Wood, that the Board indorses the petition to the Legislature for protection and aid to peach culture, and the executive committee is instructed to aid before the committee on agriculture of the Legislature in procuring the enactment of a law for the above purpose.

Voted, On motion of Mr. Hersey, that the thanks of the Board be extended to First Vice-President Grinnell for the able and pleasant manner in which he has performed the duties of presiding officer.

The records of the third day were read and approved.

Adjourned at 12.05 p.m.

WILLIAM R. SESSIONS,
Secretary.

REPORT TO THE LEGISLATURE OF THE STATE BOARD OF AGRICULTURE, ACTING AS OVERSEERS OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

[P. S., Chap. 20, Sect. 5, adopted by the Board, Feb. 5, 1896.]

The committee "on Agricultural College and education," appointed by this Board, having attended to its duty, begs leave to submit the following report: —

The college is doing the work for which it was established in a manner that meets with the approbation of its friends and supporters and proves the wisdom of its founders. Under the immediate direction of its president, Henry H. Goodell, assisted by an efficient corps of teachers, it takes rank (in the opinion of your committee) equal to that of any other institution of learning of the kind in this country.

It is pleasant to be able to report that the needed, and we may also say the generous, appropriations made by the State from time to time for the benefit of the college have been by discreet and intelligent trustees properly expended for the various purposes for which they were given. The result has been continued and gratifying progress in every department of the institution. Good work was what your committee expected and looked for, and found, in its visits, both in the class rooms and on the farm.

In previous reports we have occasionally given a brief outline of the early history of the college; but, as our Board is constantly changing, it may be interesting to the young men, and to all perhaps who have not made the subject a special study, to refresh their memory in regard to some of the most important facts as to how we came by this college and what it has accomplished.

HISTORY.

In the year 1862, at the time when the great rebellion was in progress and apparently at its very height, the United States Congress found time to consider and pass a bill, principally under the leadership of Hon. Justin S. Morrill, Senator from Vermont, donating public lands to the several States which should provide colleges for the benefit of agriculture and the mechanic arts. The act provided that the amount of land apportioned to the several States should be in proportion to the population, and to be available it must be accepted by the Legislature of each State. It also provided that the land, or land scrip, might be sold and the money invested as a perpetual fund, the capital of which should remain forever undiminished, and the interest inviolably appropriated by each State which might take and claim the benefit of the act, "to the endowment, support and maintenance of at least one college, where the leading object should be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in such a manner as the Legislatures of the States may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

The act thus passed by Congress was signed and approved by Abraham Lincoln July 2, 1862. It is claimed that Massachusetts was the first to accept it, and also to pass an act of incorporation of the college. This being done, it was approved by John A. Andrew, governor, April 29, 1863. The corporation was organized Nov. 18, 1863, with Gov. John A. Andrew president, Allen W. Dodge vice-president and Charles L. Flint secretary. Trustees were appointed by the Legislature, who were authorized to locate the college. Several sites were viewed in different parts of the State. The towns of Lexington, Springfield, Northampton and Amherst each offered to secure, by valid subscriptions or otherwise, the sum of $75,000 for the purpose of erecting suitable buildings; and, after some time taken for deliberation, Amherst was selected. The college was opened for students Oct. 2, 1867, and forty-six young men were admitted as students before the close of the first term.

The Endowment Fund.

The Legislature, in accepting the grant of the United States, directed that all moneys received by virtue of this act should be immediately deposited with the treasurer of the Commonwealth, who should invest and hold the same, in accordance with the act of Congress, in perpetual fund. The amount received and invested by the treasurer was $219,000. In 1871 a legislative resolve added a further sum of $141,575.35 (see annual report of trustees, of January, 1893, page 43).

By law two-thirds of the income of these funds is paid to the treasurer of the college and one-third to the Institute of Technology. The Institute of Technology teaches of course those branches of science which are of directly industrial importance, such as are properly included within the meaning and intent of the land grant, as a part of the work of the college, but the institute, or school, is located at Boston instead of at Amherst, and receives what is supposed to be its proper share of the endowment income.

Other Funds.

There have been from time to time various gifts, both from the State and from individuals, towards the endowment and support of the college.

One important gift was made by L. M. and H. F. Hills of Amherst, which now amounts to $8,542. The income from this gift is to be applied towards the maintenance of a botanic garden.

There is also the Mary Robinson fund of $858, without conditions. The income is used for scholarships to worthy and needy students.

The sum of $1,000 was given by the Hon. Henry Gassett as a scholarship fund.

There is a library fund for the benefit of the library, amounting now to $9,420.47.

There is also the Whiting Street fund of $1,000, without conditions.

The Grinnell prize fund was a gift of $1,000 by Ex-Gov. Wm. Claflin, and called the Grinnell fund, in honor of his friend. The income is appropriated for two prizes, to be given each year to the two members of the graduating class who pass the best examinations in agriculture.

There is also the State scholarship fund of $10,000. This sum was appropriated by the Legislature in 1886, and is paid to the college treasurer in quarterly payments.

The Morrill fund, United States grant, commenced in 1890, at $15,000, and increased each year $1,000, till the limit of $25,000 is reached, when it remains fixed at that sum. Two-thirds of this goes to the college and one-third to the Institute of Technology.

T. O. H. P. Burnham, late of Boston, made a bequest of $5,000 to the college, without conditions. The trustees have voted to keep the fund intact, and use the income for such purposes as they believe to be for the best interest of the college.

The College Farm.

After the college was located at Amherst a farm was purchased, consisting of three hundred and eighty-three and a half acres, from six separate estates. Of this, forty-eight acres have been set apart for the use of the Hatch Experiment Station and about seventy-five acres for the botanic and horticultural department, the balance being used and designated as "the farm proper." The entire amount of land under cultivation will, from year to year, perhaps average one hundred and twenty-five acres.

Experiment Stations.

There were originally situated on the college grounds two experiment stations: one was the Massachusetts State Experiment Station, which had no connection with the college, but was a separate institution, though it leased a sufficient quantity of land (forty-eight acres) belonging to the college farm for the purposes of its proper work and accommodation; the other was the Hatch Experiment Station, so called, which belonged to and was a part of the college.

It came to us in this way. In 1887 a bill came before Congress, under the care of Hon. Wm. H. Hatch of Missouri, member of the House of Representatives and chairman of the committee on agriculture, entitled, "An act to establish agricultural experiment stations in connection with the colleges established in the several States under the provisions of the act passed by Congress and approved July 2, 1862, and the acts supplementary thereto." This bill provided for the annual payment by the United States of $15,000 to the several agricultural colleges, to be expended for experimental purposes. It was passed and approved March 2, 1887.*

At a meeting of the trustees of the college, held March 2, 1888 (at Boston), to make proper provisions for the necessary organization to put this experiment station into operation, Henry H. Goodell was elected director, Wm. P. Brooks agriculturist, Samuel T. Maynard horticulturist, Chas. H. Fernald entomologist and Clarence D. Warner meteorologist. It was also decided at this meeting to name the station "The Hatch Experiment Station of the Agricultural College," in order to distinguish it from the State Experiment Station. This important branch of the college is already appreciated by all who are interested in scientific agriculture.

Consolidation of the Experiment Stations.

Chapter 143 of the Acts of the Legislature of 1894 was intended to provide for the consolidation of the Massachusetts Agricultural Experiment Station with the experiment department of the Agricultural College; but, through an error of construction, it was not adequate for the purpose. The Legislature of 1895, by chapter 57 of the Acts of that year, amended the first-mentioned act, so that consolidation was legally provided for, on the authorization of the Massachusetts Agricultural Experiment Station and the acceptance of the same by the trustees of the Massachusetts Agricultural College. This legislation became operative by the approval of the governor, Feb. 15, 1895.

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* The bill may be found in full in the issue of Feb. 18, 1888, of the "New England Homestead." See also an additional act of Aug. 30, 1890.

On April 15, 1895, the Massachusetts Agricultural Experiment Station, at a meeting legally called for that purpose, authorized the consolidation, and on the following day, April 16, the trustees of the college accepted the transfer of the property of the Massachusetts Agricultural Experiment Station, and the consolidation was complete.

The trustees proceeded at once to adopt a plan of organization for the new station, under the name of the Hatch Experiment Station of the Massachusetts Agricultural College. The plan adopted provided that the experiment station should form the experiment department of the college, and be under the direction of a committee of the trustees, and that the director should be elected annually. It was also provided that eight divisions of the experiment department should be established, — agriculture, horticulture, botany, chemistry, entomology, stock feeding, veterinary and meteorology, each under a responsible head, who should be amenable to the director for the faithful performance of the work of his division.

It was provided that the treasurer of the college shall "receive and have the custody of the money appropriated from time to time by the Congress of the United States or the Commonwealth of Massachusetts, and any and all money appropriated or donated at any time for the purposes of the experiment station; and he shall keep all such money in separate fund account, and shall pay out the same upon warrants signed by the director of the station and approved by the president of the college."

The committee of the trustees under whose direction the experiment department was placed was composed of the following-named gentlemen: Wm. R. Sessions, Charles A. Gleason, Elijah W. Wood, Wm. Wheeler and James Draper. Dr. H. H. Goodell was elected director of the station; Dr. Chas. A. Goessmann was elected honorary director; Prof. Wm. P. Brooks was appointed head of the division of agriculture; Prof. S. T. Maynard was appointed head of the division of horticulture; Prof. Geo. E. Stone was appointed head of the division of botany; Dr. C. A. Goessmann was appointed head of the division of chemistry; Dr. C. H. Fernald was appointed head of the division of entomology; Dr. J. B. Lindsey was appointed head of the division of stock feeding; Prof. J. B. Paige was appointed head of the division of veterinary; Prof. Leonard Metcalf was appointed head of the division of meteorology.

As the season's work at the two stations had been planned and commenced before consolidation was accomplished, the work of the present year is going on largely under those plans. It is believed that the work under one management can be much more economically performed, and that greater and better results will be accomplished by the consolidated station than was possible by the two working separately, and that thus the people of the State will get more for the money expended for experimental purposes.

Commencement Exercises.

Among the first duties of your committee of the past year was the examination of the graduating class in agriculture, in competition for the Grinnell prizes. We were pleased to note that the work of the class, almost without a single exception, indicated a practical knowledge of the science. The first prize was awarded to Wright A. Root of Deerfield and the second to Clarence B. Lane of Killingworth, Conn. We were present at nearly all of the commencement exercises, which showed that both graduates and students were there for a purpose. Particularly noticeable was the fine military drill of the students, under command of Lieutenant Dickinson.

Condition of the Farm.

There was time for only a hurried examination of the farm during commencement week. The hay from all of that portion about the college buildings had been secured, while the crop of timothy on the drained meadow was one of the best we ever saw.

At the time of our visit in November the harvesting was complete, and we can report all of the standard crops good. We found both barns full of hay, fifteen hundred bushels of corn, twenty-two hundred bushels of potatoes, one thousand bushels of onions and fifty tons of roots. Many of the new forage plants also are being cultivated, thus giving the students an opportunity of observing their habits of growth, as well as their relative value for feeding purposes.

The cattle stables were well filled with the herd of grade Durhams, while there are representative animals of nearly all our prominent breeds. The horse stables have an acquisition in a French coach colt, while the Percherons and their grades fill the remainder of the stalls.

At our November visit we found the land all ploughed for next season's planting, much of it having been done with a sulky plough.

Among the improvements of the past year are the laboratory at the insectary; quite a stretch of new roads completed, requiring a large amount of grading; the levelling of the wood lot south of the Hadley road, and the cultivating and seeding of the same for permanent pasture.

The Horticultural Department.

The horticultural department during the past season has been carried on in about the same lines as in former years. Comparison has been made with the following number of varieties of fruits the past season: 150 varieties of apples; 67 of pears; 49 of peaches; 103 of plums, including all the best types; 13 of apricots; 2 of nectarines; 8 of quinces, and many seedlings; 33 of cherries; 143 named varieties of grapes, and some 600 seedlings not yet fruited; 20 of currants; 17 of gooseberries; 25 of red raspberries; 31 of blackcap raspberries; 21 of blackberries; 157 named varieties of strawberries, and 500 seedlings. Plantings have also been made of several new species and hybrids. The past season was very unfavorable for close comparison, on account of the late frost in the spring, drought in the early summer, early frost in the fall and the worst wind and hailstorm known in that vicinity since the establishment of the college. The strawberry crop was very fine, though some varieties suffered from frost, notably the Marshall and Sharpless. The grape crop escaped the late spring frost and promised to give the largest crop ever harvested from the college vineyard, but was almost ruined by the hailstorm that occurred September 11, so that comparison of any but the very early kinds was made impossible. The plum crop was large and fine. Among the Japanese varieties that fruited were the Abundance, Kelsey and Satsuma. The fruit of these varieties shows considerable merit, and promises to be valuable for our market. On the land devoted to market gardening all the leading varieties of vegetables are grown and tested to illustrate the best methods of cultivation.

Sub-irrigation under glass was practised during the winter, tests being made of land tile laid one foot deep under the surface soil of the vegetable house, with good results in the growth of lettuce.

Greenhouses.

The glass structures are twelve in number. Among those recently erected is a large octagon, forty by forty feet and twenty-eight feet high, for growing specimen plants of economic and educational value. The collection of this class of plants has never been so large and in so fine condition as at the present time, and it may be safely claimed that the equipment of the horticultural department in the line of fruits, ornamental trees and other plants is the largest and most complete of any institution of the kind in the country. Spraying for insect pests and fungous diseases has been continued the past season, with satisfactory results. A new tool house recently built has a good cellar, a room for wagons and large tools, workshops for repairs, and a large storage room overhead. An addition of fifty by twenty-two feet has been added to the horse stables, for the accommodation of the work and driving horses. This added much-needed room in the basement for the storage of large farm tools and machines. This department is in a prosperous condition and is doing good work.

Four-years Course — Admission.

Candidates for admission to the freshman class will be examined, orally and in writing, upon the following subjects: English grammar, geography, United States history, physiology, physical geography, arithmetic, the metric system, algebra (through quadratics), geometry (two books) and civil government (Mowry's "Studies in Civil Government"). The standard required is 65 per cent on each paper. Diplomas from high schools will *not* be received in place of examination. Examination in the following subjects may be taken a year before the candidate expects to enter college: English grammar, geography, United States history, physical geography and physiology. Satisfactory examination in a substantial part of the subjects offered will be required, that the applicant may have credit for this preliminary examination.

A. C. VARNUM.
GEORGE CRUICKSHANKS.
E. A. HARWOOD.
JOHN BURSLEY.

FIELD CROPS.

BY PROF. WM. P. BROOKS OF AMHERST.

The subject as assigned me by the Board may be made to include a far greater number of crops than I could possibly treat of, in the brief time which is available, in a manner satisfactory either to myself or to you. I shall accordingly confine my attention to a few of the more important, selecting hoed rather than sown crops or grasses. Those which I have chosen to speak of are corn, mangels, Swedes and potatoes.

We shall do best to consider these crops for the most part separately, as I shall not attempt to deal with the many questions connected with rotation.

Some consideration of their relative capacities for food production will, however, be of interest. It may be thought that such comparison between the potato and the other crops can have little interest, since this is used almost entirely as human food, while the others are animal foods. I believe, however, that it will be instructive.

In making this comparison, I assume the yield of the corn to be at the rate of 16 tons of silage per acre, which is about our average at Amherst; for the mangels I take the yield at 26 tons per acre, our average for five years; for the Swede, 19 tons, our average for three years; and for the potato, 300 bushels, which is a little above our average, but will generally be a possible amount.

The figures which I have taken as representing the cost cover one-half the manure and three-fourths of the fertilizer applied and all the labor in each case, and in round numbers show the result of recent work on the Agricultural College farm. These figures are: for corn, $33 per acre; for mangels, $75; for Swedes, $32; and for potatoes, $50.

The comparative standing of these crops as food producers is shown in the table, to which I invite your attention: —

Comparative Productive Capacity and Cost.

CROPS.	Yield per Acre.	Digestible Protein.	Nutrients per Acre.		Per Acre.	
			Carbohydrates.	Fat.	Calories.*	Cost.
		lbs.	lbs.	lbs.		
Silage corn, .	16 tons	391	4,590	214	10,020,800	$33 00
Mangels, . .	26 tons	535	2,938	57	6,701,760	75 00
Swedes, . .	19 tons	334	2,941	42	6,268,860	32 00
Potatoes, . .	300 bush.	229	2,806	90	6,024,600	50 00

It will be noticed that the number of calories of potential energy produced by an acre of either mangels, Swedes or potatoes is approximately the same, — a little more than 6,000,000; but this number of calories is produced at widely different costs. The acre in corn produces approximately one and two-thirds as many calories as either of the others, and at very nearly the lowest total acre cost. The relative economy of these crops as food producers will be more apparent if we reduce the results to some common unit. Let us take for this common measure 10,000 calories, and find what this amount of energy costs with each of the crops under consideration. Calculation shows that 10,000 calories of energy cost: with corn as the crop, $0.033; with mangels, $0.112; with Swedes, $0.051; with potatoes, $0.083.

In view of these results, there would appear to be no doubt as to the superior economy of corn put into the silo as a crop for food production; and I may state here, without going into details, that carefully conducted experiments in feeding for milk, both at Amherst and at a number of our other experiment stations, have given results entirely in accord with the scientific deductions to which I have called attention. Thus, at Amherst 40 pounds of mangels feed, in comparison with thirty pounds of corn silage, — the same kinds and amounts of other foods being given in connection with these feeds in each instance, — gave in eight weeks 121 pounds less milk than the silage; and the cows receiving silage gained slightly in weight, while those receiving mangels lost in weight. It will cost to produce 40 pounds of mangels almost exactly twice as much as it will cost to produce the 30 pounds of silage.

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* A calorie is the quantity of heat necessary to raise the temperature of a kilogram of water from 0° to 1° centigrade.

Man, however, cannot live on corn stalks, and it may be doubted whether he would thrive on either mangels or Swedes, even should these be used in connection with some meat and other more nitrogenous foods. He can live on potatoes, with a little meat or fish. We may not, therefore, justly compare the potato with corn for the silo as a food producer. To utilize the calories of energy put into the silo, we must place a cow or a steer between the door of the silo and our mouths. Here it is usually the cow, and she should return us about 3,200 quarts of milk for the product of one acre in corn. This milk will contain only a little over 2,000,000 calories of energy, — just about one-fifth of the amount we put into the silo. The potato gives us rather over 6,000,000; so it appears that the potato as a producer of human food stands far ahead of corn utilized through the medium of the cow. Should we ourselves consume the grain produced by an acre in corn, and feed the stover to cows, the two would stand more nearly upon an equality. On the basis of a yield of 75 bushels of grain and 2½ tons of stover, I figure, in grain, 7,057,620 calories, and in the milk which could be produced by the stover a little over 1,000,000 calories, — a total of 8,071,620 calories of energy. The corn on this basis stands ahead of the potato; but corn is much less palatable than the potato as an every-day food, and, moreover, requires expensive and laborious preparation, while the potato does not. We see, therefore, that among the crops under consideration the potato stands at the head as a human food producer; and I may add that among all the crops that can be grown in temperate climates there is probably not one which can equal it in respect to the amount of human food which can be produced from a given area. It would undoubtedly be quite as difficult to produce 40 bushels of wheat as 300 bushels of potatoes; and, if we consume all the grain and make the straw into milk, we shall obtain only 4,251,744 calories from the product of one acre, which is only about two-thirds of the quantity from an acre of potatoes.

INDIAN CORN (*Zea Mays*).

This crop is a member of the grass family, and was undoubtedly indigenous to the American continent. It was extensively cultivated by the American Indians at the time of the discovery of the New World by Columbus, and even at that time there was a large number of different varieties. It is not definitely known from what form or forms our cultivated varieties have sprung. It is often stated that the so-called "pod" corn — a variety in which each kernel upon the ear is enveloped in a separate husk — is probably the parent form, or that the wild type produced grain in the tassel, each kernel enveloped in a husk, — the fact that corn even now sometimes produces grain in the tassel being brought forward as evidence; but there is no proof that either supposition is correct.

Within a few years the attention of botanists has been called to a new species, which has been called *Zea canina*, because of the fact that the kernels are shaped like a dog's teeth. This was found growing wild in Mexico, and the natives of this district are said to look upon it as the original source of the cultivated varieties of maize. This species has been cultivated in the botanic gardens at Cambridge and by Professor Bailey at Ithaca. As grown at Cambridge, the tallest stalks were over ten feet high, with a diameter of nearly two inches; but "the most striking peculiarity of the plants was the abundance of lusty suckers, which grew as rapidly as the main stalk, so that the plants, which had fortunately been placed some feet apart, had the appearance of two hills, one of the two bearing nine and the other twelve stalks ascending from a common base." The central stalk also branched higher up on the trunk, and these side branches, as also those from the base of the plants, had a tassel upon the ends and bore several ears along their length. The ears were only about two inches long, and had but four rows of pointed white kernels. Professor Bailey has crossed this species with a Japanese corn, and from one of the hybrid seeds raised thirty-four ears. Professor Bailey thinks this corn is not a distinct species, but either the original or very near the original form of *Zea mays*.

Production.

Professor Hunt of the Ohio Agricultural College states that the total production of corn in the entire world is probably about 3,000,000,000 bushels, or about one and one-half times as much as of wheat. Of this enormous total the American continent produces from three-fourths to four-fifths. Within a decade the United States has several times produced more than 2,000,000,000 bushels, and this year has probably produced nearly 2,500,000,000 bushels, or probably twice as great a quantity as all the rest of the world taken together. Our average yield per acre for the entire country is now about 24 bushels. Ten years ago it was about 27 bushels. Massachusetts averages about 40 bushels per acre. But little of the corn raised in the United States is exported, seldom more than five per cent. Our consumption averages about 28 bushels per individual of our population. This is the heaviest rate of consumption of any cereal by any people in the world. It is nearly twice as great as the consumption of all the cereals in Europe.

We probably produce annually rather over 50,000,000 tons of corn stover, which is very largely wasted. The production in this State is probably 81,000 tons, of which I estimate that fully one-half is wasted, involving a money loss of about $245,000. This loss may be almost entirely avoided by better methods of handling the corn crop. These methods will be described later.

Varieties.

It is a well-known fact that there is an enormous number of varieties of corn. Into the question of the relative merits of these varieties I cannot go. You are aware that flint varieties have usually been grown in Massachusetts. There is considerable evidence tending to show that dent varieties have superior capacity for productiveness, whether of grain or of total crop for fodder or the silo.

Within recent years a number of varieties of dent corn capable of maturing in Massachusetts have been introduced, and, especially in the Connecticut valley, these are to a considerable extent displacing the old flint varieties. Among these the "Pride of the North" is undoubtedly one of the best, whether for grain or ensilage. Many, however, prefer for ensilage a somewhat later variety. Among those of this type the "Leaming" is one of the best. It sometimes ripens with us, but would not be reliable as a field crop for grain. It will almost invariably become sufficiently mature for the silo before frost. Among flint varieties I have a high opinion of the "Longfellow," both for grain and ensilage.

Soil.

The qualities of the soil best for corn are generally so well known that extended discussion of this topic is unnecessary. Corn thrives upon a wide variety of soils if the season be hot, provided the rainfall is well distributed and of average quantity. The subsoil must not be waterlogged; but, provided the water table is at least three feet below the surface, the soil may be tolerably heavy with advantage. The best corn crop that I have ever seen was raised at Amherst, in 1894, upon a field with moderately retentive soil which was tile-drained in 1889. The area was 10 acres, and the product was 1,062 bushels of shelled grain and 39 tons and 650 pounds of stover. The variety was the "Pride of the North," and the field received per acre 4 cords of manure, 100 pounds of nitrate of soda, 200 pounds of plain superphosphate, 200 pounds of South Carolina rock phosphate and 150 pounds of muriate of potash.

Manures and Fertilizers.

As indicated by the statement just made, it is my usual practice to employ both manures and fertilizers in raising corn. The land is fall-ploughed and the manure hauled as fast as made and spread during the winter. The land is reploughed in the spring, and the most of the fertilizers, mixed just before spreading, are put on broadcast and harrowed in. In the case of the crop just alluded to, the nitrate of soda, one-half of the superphosphate and one-half of the potash were mixed and put in the drill, being dropped by the same machine which planted the corn, and my practice has usually been similar.

As most of you are aware, I have during the last few years tried many experiments with a view to getting light as to the manurial and fertilizer requirements of corn. The details of these experiments and the full discussion of the results may be found in the published reports and bulletins of the Hatch Experiment Station. I shall not take your time to present them on this occasion. Suffice it to say that these experiments, which have been in a large measure confirmed by others, indicate the following conclusions: —

1. It is usually unnecessary to supply a large amount of available nitrogen for the corn crop, and this is explained by the fact that, growing as it does chiefly after considerable warm weather, it can depend largely upon the nitrogen of the organic matter of the soil which becomes available under the influence of natural agencies during the summer.

2. The corn crop does not make a heavy draft upon the phosphoric acid of the soil, and it is not economy to apply this element largely.

3. The yield both of grain and stover is largely dependent upon the supply of potash. This should be prominent in a fertilizer for this crop; and, even if nothing else is employed with manure, it will generally be found profitable to use with it some muriate of potash.

A crop of 75 bushels of grain and 2¼ tons of stover will take from the soil about 121 pounds of nitrogen, 43 pounds of phosphoric acid and 81 pounds of actual potash; 15 tons of average corn silage will take 100 pounds of nitrogen, 37 pounds of phosphoric acid and 118 pounds of potash. It will be noticed that the potash is relatively more and the phosphoric acid less abundant in the silage. This is due to the fact that the proportion of ears in the latter is smaller, the phosphoric acid being more prominent in the grain and the potash in the stalk and leaf. The manure and fertilizers used per acre for our corn crops upon the college farm during the past season, and the estimate of plant food supplied to the soil and removed therefrom in the crops, are as follows: —

Field Corn.

Nitrate of soda,	125 pounds.
Dried blood,	200 "
Dry fish,	200 "
Cotton-seed meal,	200 "
Plain superphosphate,	200 "
Floats,	100 "
Muriate of potash,	200 "

Silage Corn.

Manure,	5 cords.
Nitrate of soda,	100 pounds.
Dried blood,	100 "
Dry fish,	100 "
Plain superphosphate,	100 "
Floats,	100 "
Muriate of potash,	125 "

	Field Corn.		Silage Corn.	
	Supplied.	Removed.	Supplied.	Removed.
	lbs.	lbs.	lbs.	lbs.
Nitrogen,	68	121	184	100
Phosphoric acid,	71	43	146	37
Potash,	103	81	227	118

I desire to call your attention to the fact that in the case of the crop for which fertilizer only was used the supply of nitrogen was less than the estimated amount removed in the crop. The field was one in which I felt sure that the decaying humus could furnish the crop a considerable proportion of the nitrogen required.

In both cases an excess of both phosphoric acid and potash was supplied. This was in accordance with my plan to secure a large available supply of these constituents, which the soil can be depended upon to hold, so that the productive capacity of the land in future years may be increased. It will be noticed that the surplus was supplied in cheap raw materials, such as manure, South Carolina rock and muriate of potash.

For the silage corn there was also an excess of nitrogen; but this was in the form of the slow-acting organic constituents of manure; and, as the land was to be seeded in the corn, I considered it desirable to have a considerable surplus of nitrogen for the grass.

I believe that some have thought that, while the corn crop in my experiments has almost invariably been largely increased by the use of muriate of potash at first, such effect would not long be found to follow its use. I have myself been surprised at the extent of its influence, even after six years' continuous cropping.

In soil test experiments in Amherst in the sixth year upon the same ground the average increase per acre in shelled corn due to the use of potash was 29 bushels; there was no average increase due to nitrogen, and less than 2 bushels due to phosphoric acid.

In similar experiments in Hadley in the sixth year the increases were: for potash, 23 bushels; for nitrogen, 9 bushels; for phosphoric acid there was no increase.

In Concord in similar work in the sixth year upon the same ground the increases were: for potash, 22 bushels; for nitrogen, 3 bushels; for phosphoric acid, 2 bushels.

In view of these results, as well as the fine crops secured upon the college farm, by liberal potash manuring, it does not seem possible to doubt that there should be less phosphate and more potash in fertilizers for this crop.

Planting and Culture.

Experiments for comparison of hill and drill planting in Amherst have been generally favorable to the drill system; in other places the results have been various. For the silo, corn should undoubtedly be planted in drills; where grain is the object, there does not appear to be much choice. The labor is rather less under the hill system. Whether the one or the other system is followed, there are numerous machines which will enable one to do the work at less expense than by hand. Many of these machines will put in fertilizer as well as seed in a very satisfactory manner.

Corn is a shallow-feeding plant, and its culture should be confined to the surface. Z. Breed's weeder is one of the best implements for use in the corn field that I know. This is used to advantage whenever the weeds are seen to be breaking the ground until the corn is a foot and a half high. Thereafter a cultivator running not more than two or three inches deep should be employed. For work upon a large scale a two-horse implement can be recommended.

Harvesting.

The corn harvester appears to have been brought to such a degree of perfection that its use is now profitable in large fields. It cuts the corn and binds the bundles with cord. In case of field corn, these bundles can easily be set up in stooks. If for the silo, they are readily loaded, and, if a cutter with sufficient power can be employed, they may be run through without first breaking the bundles.

The corn husker and fodder cutter combined is, in the opinion of some, a success; others have not found it so; and, as I have not had the opportunity to see the machine in operation, I cannot pretend to decide upon its merits. I am convinced, however, that good silage may be made from stover cut and put into the silo as early as the corn can be husked; and, where grain and fodder are wanted for different animals, I look upon the system with favor. The ears can of course be picked by hand and the fodder cut and at once put into the silo.

It seems impossible to doubt, in view of the many favorable reports, that ensilage affords the best means of utilizing the corn crop; and, where the animals to be fed need so much grain, it appears to be best to ensile ears as well as stalks. Ensilage is enabling our farmers to rapidly increase the number of cows kept and to produce milk at a lower cost than ever before, and seems destined to raise still higher in popular esteem that crop which has been well designated the "best gift of God to the American people;" the crop which so often stood between our forefathers and starvation; the crop of which Whittier sang: —

"Heap high the farmer's wintry hoard!
Heap high the golden corn!
No richer gift has Autumn poured
From out her lavish horn.

"Let other lands, exulting, glean
The apple from the pine,
The orange from its glossy green,
The cluster from the vine;

. . . .

"But let the good old corn adorn
The hills our fathers trod;
Still let us, for His golden corn,
Send up our thanks to God."

Mangels.

The various classes and varieties of beets, mangels, sugar beets and table beets are all from the same wild species, which seems to have been indigenous to the shores and some of the islands of the Mediterranean. In the wild form the root is small and tough. The great increase in its size and succulence and the wide variety exhibited in size, form, color and composition are the results of cultivation and selection. The mangel, or mangel-wurzel, and the sugar beet are very closely related, the latter being only a small and very saccharine variety of the class to which they both belong. The beet has been cultivated more than two thousand years.

It is impossible to present statistics showing the extent to which it is cultivated in Massachusetts or the United States. It is one of the leading farm crops in England, where it occupied 339,000 acres in 1894, standing sixth in the list of cultivated crops. It has never been a very important crop with us, though formerly more prominent than at the present time. The more important conditions which have lessened its culture among us are: first, its inferiority to corn as a food producer, the corn crop, as has been shown, producing more food at a lower cost per acre; second, the high labor cost, relatively much greater here than in England, where the daily wages of farm laborers are hardly one-half what they are with us, and where women and children can be depended upon to do most of the weeding; and, third, the uncertainty of the crop, it being much more affected by variations in season, particularly by hot, dry weather, than is corn.

The mangel constitutes a valuable and exceedingly wholesome food for most classes of stock, and is particularly valuable for milk production. Its flavor is agreeable to milch cows, and it does not unfavorably influence the flavor of dairy products. Its succulence is a valuable quality, rendering it highly conducive to health and appetite for other feeds.

Now that we can preserve the corn crop in succulent form, however, the necessity for roots has diminished, and the introduction of ensilage is lessening the attention given to this crop.

It needs a deep, rich and moderately heavy soil and high manuring. I regard the Globe varieties — the Yellow and the Orange — as among the best.

I should use both manure and fertilizers as a rule for this crop; but last year, on account of having kept less stock than usual, we had insufficient manure, and we depended entirely upon fertilizers, all of which were mixed and put on broadcast after ploughing, and harrowed in.

The materials applied, the amount of plant food they furnished and the amounts the crop was estimated to remove from the soil were as follows: —

Nitrate of soda, ...	200	pounds	per acre.
Dried blood, ...	200	"	"
Dry ground fish, ...	400	"	"
Cotton-seed meal, ...	300	"	"
Plain superphosphate, ...	300	"	"
Floats, ...	150	"	"
Muriate of potash, ...	600	"	"

	Contents.	
	Fertilizer.	Crop.
	lbs.	lbs.
Nitrogen,	100	120
Phosphoric acid,	91	60
Potash,	300	230

The crop aimed at and provided for by these fertilizers was 30 tons. The season, because of its dryness, was unfavorable, and our harvest was but about one-half that quantity.

I would call particular attention to the enormous quantity of potash required by this crop, and would further say that the muriate is with little doubt the best form of potash for the mangel. You will remember that I have stated that the beet was originally a seaside plant. This fact perhaps accounts for its flourishing in the presence of more chlorine than suits most crops. In case manure is depended upon for the three leading elements of fertility, I have always found the application of common salt favorable to the mangel; about 200 pounds per acre is ordinarily sufficient.

Manure at the rate of 8 or 10 cords per acre is not too much for the mangel, and with that amount I would ordinarily employ about 150 pounds of nitrate of soda, 200 pounds of muriate of potash and perhaps 150 pounds of plain superphosphate. With a crop involving so much labor as this, we cannot afford to run the risk of partial failure because of insufficient fertility.

Planting and Culture.

The mangel should be planted early, that it may have the advantage of the comparatively cool and moist weather of early spring to get well and deeply rooted. Under these conditions, with abundant fertility, it is far less injuriously affected by heat and drought.

The seed is of rather slow and uncertain germination, and hence should be used in large amount. We must avoid transplanting, if possible, for the transplanted root never becomes as large as one which grows from the seed in place. I now generally use about 6 pounds of seed per acre. The soil should be deeply pulverized and most carefully prepared.

Concerning the culture of the crop I fear I can say little of value. At best there must be considerable hand work. The crop should be planted widely enough to allow horse cultivation, using at first a shallow-working implement and later one that will work a little deeper.

Harvesting, Storing and Feeding.

The crop may remain in the field until about the 20th of October, and keeps better if not harvested much earlier than this date. This operation is hand work, the roots being pulled and the tops twisted off with the hand. The roots can be stored in considerable bulk in cool, dry cellars, but keep better in piles in the field. Plough a strip about six feet wide, as deep as convenient, and throw the earth loosened by the plough out at the sides. This strip may be of any length desired, but had best run north-west and south-east, as less surface is exposed to the cold wind, and the snow will lie on the pile more evenly.

The roots, which should be pulled when the soil is dry and the day good, are put into piles about six feet wide at the bottom and about four feet high in the middle. The earth which has been thrown out is used in covering. The cover at first should be only two or three inches deep, but must be increased as the weather grows cooler. The final earth covering should be about eight or ten inches, and just before severe weather the pile should be covered with straw, marsh hay or leaves, to the depth of about a foot. In such a pile the roots keep perfectly fresh and sound, if the work is done properly. If the cover is put on too early or is too thick, they will sprout and rot.

It may not generally be known that mangels increase in feeding value by keeping up to the time when they begin to grow. If fed in autumn or early winter, they are very laxative in effect. As the season advances, chemical changes take place in the root which render them less laxative and richer in available nutrients.

SWEDES.

Concerning this crop I shall be very brief, both because it is comparatively unimportant with us, and because in many respects it is subject to the same conditions which affect the mangels.

The Swede is an improved form of a species found wild in various parts of Europe and Siberia, but most abundantly in the northern portions. It has been cultivated much longer than the beet; according to De Candolle, for more than four thousand years, or at least some varieties of turnips have been cultivated that length of time. The Swede was not, however, extensively cultivated as a field crop among the English until about 1730. It is now, in a sense, the foundation of English stock farming, being after grass the principal stock food of the country. Swedes and English turnips combined, in 1894, occupied 1,424,000 acres of land in England, the only crops more largely grown being grass, wheat, barley and oats. With us it has been and is in large measure affected by the conditions discussed in connection with mangels, and the results have in general been similar. The Swede, however, occupies the land a considerably shorter time than mangels, and, growing much more rapidly, the cost is less.

On the other hand, though highly relished and exceedingly wholesome, the turnip cannot be as freely used as food for cows as the mangel, as it imparts its peculiar flavor to dairy products, unless used in only moderate quantities and fed just after milking.

Soil and Manures.

The turnip may be cultivated upon a considerable variety of soils, but does best on those not too heavy. On the heavy soils the roots are likely to be branched excessively, and are of inferior appearance and quality. The crop is a rank feeder and an exhaustive one to the soil. I should generally use both manure and fertilizers in growing it.

The fertilizers used during the past season, the food they supplied and that which it was estimated a good crop would remove from the soil were as follows: —

Nitrate of soda, ...	125 pounds per acre.
Dried blood, ...	150 " "
Dry ground fish, ...	200 " "
Cotton-seed meal, ...	300 " "
Plain superphosphate, ...	200 " "
Floats, ...	150 " "
Muriate of potash, ...	400 " "

	Plant Food.	
	Fertilizer.	Crop.
	lbs.	lbs.
Nitrogen, ...	68	76
Phosphoric acid, ...	84	49
Potash, ...	200	196

The crop for which I calculated was 20 tons. The hail injured the plants severely, and the yield was not quite one-half that amount. It will be noticed that the crop makes a very heavy demand for potash. Experiment and the every-day experience of many practical farmers, both in England and in this country, has shown that this crop is dependent to an unusual degree upon an abundant supply of available phosphoric acid. Hence in England superphosphates are generally largely used in connection with manure, and I have secured the best results when I have followed this plan.

In this connection our experience this year in the growth of white mustard, a member of the turnip family, is of particular interest. White mustard seed was sown about the 1st of August upon what we call the "south soil-test acre." This land has for seven years received upon one plat nitrate of soda, upon another dissolved bone-black, upon another muriate of potash, upon another nitrate of soda and bone-black, upon one nitrate and potash, upon one bone-black and potash, and upon one the nitrate of soda, dissolved bone-black and potash, in each case the same amounts every year.

Upon this acre the rotation has been corn, corn, oats, grass and clover, grass and clover, corn and rye. The mustard was sown after the rye was removed, the past season. On this land corn has each year been most increased by the muriate of potash, oats and the first cut of hay by the nitrate of soda and clover by the potash. Not one of these crops has been much increased by the dissolved bone-black. The mustard, on the other hand, made almost no growth except on the plats which have been manured with the dissolved bone-black. Even on that which for seven years has received only bone-black the growth was good.

In view of these results, I am led to advise the liberal use of superphosphate with muriate of potash in connection with manure for this crop. As it makes its growth chiefly after warm weather, it will be unnecessary to supply much nitrogen in available form.

Planting, Culture, Harvesting and Storing.

The Swede as a field crop for stock should be planted early in June, in rows about thirty inches apart. About two pounds of seed per acre are required. I have found Laing's Swede the most satisfactory variety. The plants, as is well known, can be transplanted with far greater facility than mangels, but still it is desirable to avoid this labor. The culture and general management are the same as for mangels, but much less laborious, on account of the more rapid growth.

The Swede is less injured by frost than almost any other farm crop, and may stand in the field, as a rule, until early in November. It may be harvested and stored as described for mangels, save that it will be preferable to cut the tops.

It is used to greatest advantage as food for sheep, young cattle and horses.

THE POTATO.

As is generally well known, the cultivated potato is an improved form of species indigenous to South America, Chili and Peru, it is thought. In the wild species the tubers are of very small size, and have a bitter flavor. Seed bulbs and seed are abundantly produced. The ability to produce seed is a quality which most of our cultivated varieties have almost entirely lost. This change is thought by some to indicate a loss of vitality or constitution, but I do not so regard it. Nature makes it a rule to get rid of useless parts. A "*bald* and toothless" future is foretold by some as a penalty for our increasing use of soft foods and close felt hats. Some think the little toe is doomed. In a state of nature the potato was doubtless often propagated from seed; the ability to make seeds was useful to the species. Under the care of man, seed propagation is infrequently resorted to, propagation from tubers the almost invariable rule; accordingly, nature turns the energies of the plant towards tuber and not towards seed production. The orange in Japan, from long propagation by grafting and budding, is almost always seedless. The trees are yet vigorous, long-lived and productive.

The horse-radish seldom or never produces seeds, its vigorously spreading roots sufficiently providing for its multiplication. No one will accuse the horse-radish of lack of vitality or constitution.

It is certainly true that varieties run out, and possibly true that the potato is now more subject to disease than formerly, — certainly disease is more common; but the failure to produce seed is not evidence of this change.

The potato was found under cultivation at the time of the discovery of America by Columbus, but De Candolle thinks it had not been cultivated long.

Of course you are all aware that the potato is an important crop among us, but it may not be equally well known that it is relatively far less prominent and important here than in many other countries. In Germany the crop is raised in enormously greater quantity than in the United States; and even the United Kingdom of Great Britain and Ireland usually raises more potatoes than this entire country. Thus, in 1893, we raised 183,034,203 bushels and the United Kingdom 215,853,000 bushels. Our crop in that year, however, was a little below our average, while that of Great Britain was slightly above the average. This year we have raised a far larger crop.

Mere aggregates, however, signify little. The product per acre is far more important. Here we find little occasion for self-satisfaction. The average per acre in Great Britain and Ireland is 192 bushels. In the United States, in the ten years from 1870–79, the average was 87.7 bushels; in the nine years from 1880–88 it was 76.3 bushels. Even in our own State the average product is only about one-half of the English average. It is undoubtedly true that our climate is somewhat less favorable to large yields than is that of the British Islands, as the crop is easily injured by dry weather, to which we are peculiarly susceptible; and it may be true that the larger proportion of early varieties here in Massachusetts serves to keep our average low. Still, in view of the possible and frequently obtained yields of 300 or more bushels per acre, the low average of less than 100 bushels is evidence of much poor farming among us.

The number of varieties from which one may choose is very great, but early varieties are generally most profitable with us, and there are but few that are cultivated to any great extent. The Early Rose and Early Beauty of Hebron are still the favorite kinds in Massachusetts.

Change of Seed.

The potato, cultivated continuously upon almost any of our soils under prevailing conditions, rapidly loses in productive capacity, as a rule; and it abundantly pays to change the seed — not necessarily the variety — frequently. I believe it best to change every year. I have not a wide experience with seed of the same variety from different localities. It is, however, a general rule in changing seed that the new stock should come from a locality somewhat north of one's own; and in practice I have found seed from Aroostook County, Me., very satisfactory. On several occasions under otherwise similar conditions we have raised Beauty of Hebron potatoes from our own seed and from Maine seed, and always with results highly favorable to the latter. In a number of instances our own seed was the product of the first year from Maine stock, and in all cases it has been equal in appearance to the imported seed, and yet the difference in yield has always been far more than enough to cover the increased cost of the purchased seed. Thus, for example, in one experiment, in 1894, the difference in favor of the Maine seed was at the rate of 36.5 bushels per acre. In the fields upon the college farm the differences due to seed have been less accurately determined, but have apparently been greater than in this experiment.

Soil and Fertilizers.

The best soil for quality and earliness is one which is quite light; for large product, a medium loam which is well drained and which will yet hold the water quite retentively is to be preferred, though the chances of disease may be somewhat greater.

The practice of the majority of our farmers indicates that this crop can, as a rule, be grown most successfully and most profitably on fertilizers. So grown, it is freer from rot and scab and of better quality than on manure.

The potato does not withdraw from the soil a very large amount of the elements of plant food, and yet it is generally recognized that to grow it successfully the soil must be liberally supplied with the elements of fertility. This crop has a limited root system, and, as we cultivate it, must make the chief part of its growth in about sixty days. These facts explain why plant food must be so liberally supplied to the potato crop.

The materials applied for our crop last year, the plant food supplied and the amount which would have been removed in the crop aimed at were as follows: —

Nitrate of soda, ...	125 pounds per acre.
Dried blood, ...	200 " "
Dry ground fish, ...	100 " "
Cotton-seed meal, ...	200 " "
Plain superphosphate, ...	400 " "
Floats, ...	100 " "
Sulphate of potash (high grade), .	300 " "

	Contents.	
	Fertilizer.	Crop.
	lbs.	
Nitrogen, ...	61	48
Phosphoric acid, ...	91	17
Potash, ...	153	72

It will be noticed that there was a large excess of phosphoric acid supplied. This is in part due to our plan to enrich the soils in this element with a view to future crops; but was in part furnished with a view to hastening the maturity of the crop, or, in other words, to make it earlier. It is well known that the usual effect of an abundant supply of available phosphoric acid is in that direction. I should state that we did not get the desired results this year, possibly because there was too much available nitrogen present in the soil.

I desire to call attention to the fact that the sulphate was used as the source of potash. Experiments which have been repeated many times on different soils and extending through five years have convinced me that this form is much superior to the muriate, giving larger yields of better quality. The details of these experiments will be found in reports and bulletins by Dr. Goessmann and by myself, and I will not detain you by presenting them at this time. Suffice it to say that the yield where sulphate has been used has been far more than enough greater than where the muriate was used to cover the higher cost of the former. I wish to make emphatic the expression of my belief that all potato fertilizers should contain sulphate and not muriate as the source of potash.

Experiments at Amherst indicate that where the amount of fertilizer used is moderate, it is best to scatter widely in the drill rather than broadcast. Where the amount is large, a combination of the two methods seems to be preferable. It is perhaps unnecessary to add that the portion applied in the drill should include the more readily available materials. With such a selection as that used last year, I should put in the drill the nitrate of soda, the dried blood, one-half the superphosphate and one-half the potash. The balance of the materials I should mix, spread after ploughing and harrow in.

Preparation of the Soil, Planting and Culture.

With medium loam I prefer to plough in the fall, and then to plough again in the spring and make fine with the harrow. I prefer to plant as early as the soil can be brought into suitable condition, and use tubers of merchantable size cut into pieces with two or three eyes each. I am aware that larger yields have been obtained by planting whole tubers; but the increased cost of the seed and the greater probability of a larger proportion of small tubers are disadvantages which I believe offset any slight gain in total yield.

For the last five years we have used the Aspinwall potato planter, which is undoubtedly the best machine for the work; but, after thorough trial of the machine, I have decided to plant hereafter by hand. Under the most favorable conditions we have had at least one vacant space for every ten pieces planted. This of course means that one-tenth of the ground is unoccupied, and, with our average crop, signifies a shortage of from 25 to 30 bushels, which, even at this year's prices, bring more than enough to cover the increased cost of hand planting.

Culture.

The harrow and Breed's weeder, and Prout's horse hoe for ridging, which we find to be necessary to prevent exposure of tubers to the light and air, make the care of the crop easy and inexpensive. The labor cost of the crop on our best field, in 1894, when stored in the cellar, amounted to about 12 cents per bushel. The cost of labor and seed, with a poorer crop, in 1895, was 19 cents. The fertilizer draft upon the soil is covered at the cost of 5 cents per bushel.

Protection from the Bugs.

During the last two seasons we have used Leggett's Paris green gun for the application of this poison, with most satisfactory results. This little implement, which costs about eight dollars, applies the unmixed "green" in quantities as desired, in an excellent manner. A man will cover about an acre an hour for a short time; a day's work would be about six acres. I estimate the saving in labor and plaster (ordinarily used where the "green" is applied dry) to amount to about $5 per acre.

Protection from Blight and Rot.

That well-nigh perfect protection from blight and rot is afforded by seasonable spraying with Bordeaux mixture is abundantly demonstrated by results obtained in many places. My own results have been inconclusive, for the reason that where the treatment has been tried there has been practically no rot in any part of the field.

Prevention of Scab.

The formation of scab on potatoes is due to the growth of a parasitic fungus on or in the skin. This fungus comes from spores or seed, and these spores are often put into the ground with the seed potatoes planted. A sound crop may be grown from scabby seed, because the spores on such seed can be killed without lessening the vitality of the tubers. No practical method is known for destroying the spores of scab which are likely to be found in the soil where a scabby crop has recently been grown. Safety from contagion from this source can be secured only by rotation of crops. If the crop upon any field has been scabby, it is not best to plant that field with potatoes again within less than four or five years.

Seed that is scabby can be rendered fit to plant by first washing and then soaking about one and one-half hours in a solution of corrosive sublimate in water, in the proportion of two and one-fourth ounces to fifteen gallons of water. It is best to dissolve the sublimate first in a small quantity of hot water. It should be remembered that the corrosive sublimate is a dangerous poison if taken internally. Wooden vessels should be used to hold the solution, as it will corrode metals.

The potatoes after soaking are taken out, spread to dry, and should then be at once cut and planted. Do not cut before the treatment. The same solution can be repeatedly used, but should be thrown where no animals can reach it, after all the seed has been treated.

This method is fully described in Bulletin No. 9 of the North Dakota Experiment Station, by its discoverer, Professor Bolley.

Harvesting and Storing.

The potato digger has now been brought to such a degree of perfection that its use in large fields is an essential to economy. One of the best machines is "Hoover's," costing about $65. This can be drawn by two stout horses, but four are better. It does clean work, leaving nearly all the tubers in sight, and throwing the tops and weeds to one side. It injures but few tubers. In large fields I estimate the saving from its use, as compared with hand digging, to amount to nearly $5 per acre.

Potatoes should be dug when the soil is dry, and should be exposed to the sun and air only long enough to allow exterior moisture to dry off.

It appears to be best to sort as picked up, to avoid rehandling. Pick up first the merchantable tubers into bushel baskets, and empty into sacks in which they can be most conveniently handled.

Store in a dry, cool cellar, in piles or bins not more than about two and one-half feet deep, and with opportunity for air to circulate beneath and through the pile.

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TUBERCULIN,—WHAT IT IS; HOW IT IS USED; WHAT IT DOES.

BY PROF. JAS. B. PAIGE, VETERINARIAN TO THE BOARD.

What it is.

Tuberculin is the sterilized and filtered glycerine extract of the bacillus tuberculosis. It contains an active principle, chemically complex in its composition, which is produced by the functional activity of the germ.

The first step in its preparation is the cultivation in the laboratory upon suitable nutrient material of large numbers of the germs. These by their growth produce the active principle. The culture is then treated with glycerine, filtered through porcelain to remove the living germs, after which it is sterilized by being subjected to the action of a high temperature. To make it more concentrated, a part of the fluid is evaporated at a low temperature, and carbolic acid added as a preservative.

By the process of filtration and sterilization all germs in the culture are either removed or destroyed, while the product of their growth remains active in the tuberculin.

As the active principle is not living matter, and can in no way produce such, the injection of tuberculin into the system of a healthy animal cannot by any possible means give rise to the disease tuberculosis.

How it is used.

To be accurate, the temperature of the animal to be tested should be taken several times, at intervals of two or three hours, during the day, by inserting into the rectum an ordinary fever thermometer. The last reading should be taken late in the afternoon or during early evening. The several readings are for the purpose of finding the normal temperature previous to the employment of the tuberculin. Ordinarily, with animals under normal conditions, it is hardly necessary to take more than two or three readings, the last of which should be made just before the tuberculin is used. A careful record of all temperatures should be kept, and should any be found higher than normal, the testing should be postponed until the temperature has returned to its normal. This varies in different animals within comparatively narrow limits under varying conditions, but should never as a rule be above 102° or 102.5° F.

Having obtained the normal temperature of the animal, the tuberculin should be prepared for use. When it is purchased in the concentrated form it should be diluted, one part of tuberculin being added to nine parts of a 1 per cent solution of carbolic acid, prepared with distilled water. By some manufacturers it is diluted before being sold; in such cases it is to be used in the form in which it is purchased.

To prepare the animal for the injection of the tuberculin, the hair should be clipped from a part of the skin as large as a silver dollar, on the neck, brisket, on the part of the side just back of the elbow or at a point just back of the scapula, midway between the backbone and the point of the elbow. This area should then be thoroughly cleansed with a 5 per cent solution of carbolic acid. A strong hypodermic syringe, with a capacity of about 2½ cubic centimeters, thoroughly cleaned by being filled and emptied several times with a 5 per cent solution of carbolic acid or some other equally good antiseptic, should be filled with the dilute solution of tuberculin. A whole or a part of the contents of the syringe may then be injected under the skin of that portion of the body previously prepared for its introduction.

After removal of the needle, a few light strokes with the fingers upon the part will serve to spread the fluid evenly about under the skin. Care should be taken not to inject any air with the solution. This can be easily avoided by holding the syringe, after it has been filled, needle end up, when the bubble of air will rise to the top of the column of fluid and can then be forced out by pressing upon the piston until the solution appears at the point of the needle.

The quantity of tuberculin to be used depends upon condition, and varies from 1 to 3 cubic centimeters of the 10 per cent mixture. The dose for an average-sized cow is about 2.5 cubic centimeters, while 1 cubic centimeter would be sufficient for a yearling.

If the animal is suspected of being tuberculous on account of unthriftiness and emaciation, a comparatively large quantity should be used, as it has been found in many cases that animals in the advanced stages of tuberculosis do not respond to the test as readily as those in the early stages.

It is best to administer the tuberculin during the latter part of the day, when the temperature is normally highest. After it is used the animal should be kept as quiet as possible in the stable for at least twenty-four hours. During this time but small quantities of food or water should be allowed, and all treatment that would tend to cause excitement should be carefully avoided. After a period of six hours has elapsed, following the injection of the tuberculin, the temperature should be accurately taken at intervals of two or two and one-half hours for twenty-four hours, counting from the time the injection was made.

What it does.

The value of tuberculin as a diagnostic of tuberculosis in cattle depends upon the fact discovered by Dr. Koch in his employment of it as a cure for tuberculosis in persons; that, when injected into the body of a tuberculous patient, its use is followed by the development of febrile symptoms, the most constant and noticeable of which was a rise of the internal temperature. When employed in a similar manner upon one not a subject of the disease, no marked alterations of the normal functions occurred.

As an illustration, the following tables are introduced to show what might be expected in case of the use of tuberculin upon two cows, one of which is healthy, the other tuberculous: —

Healthy Cow.

8 P.M., normal temperature, 101.4° F.

8.30 P.M., tested with 2.5 cubic centimeters 10 per cent tuberculin solution.

2.30 A.M.,	temperature,	101.2°.
4.30 A.M.,	"	101.1°.
6.30 A.M.,	"	101°.
8.30 A.M.,	"	101°.
11.00 A.M.,	"	101.2°.
1.30 P.M.,	"	101.2°.
4.00 P.M.,	"	102°.
7.00 P.M.,	"	101.3°.

Tuberculous Cow.

8 P.M., normal temperature, 100° F.

8.30 P.M., tested with 2.5 cubic centimeters 10 per cent tuberculin solution.

2.30 A.M.,	temperature,	100.2°.
4.30 A.M.,	"	101.2°.
6.30 A.M.,	"	103°.
8.30 A.M.,	"	104°.
11.00 A.M.,	"	104.4°.
1.30 P.M.,	"	106.1°.
4.00 P.M.,	"	105.2°.
7.00 P.M.,	"	104.4°.

While these two examples show what the action of tuberculin usually is in case of healthy and tuberculous animals, unfortunately the difference is not always so well marked, and with but a slight elevation of the temperature in either healthy or diseased, it sometimes becomes impossible to say from the variations whether an animal is the subject of the disease or not. In all instances where there is a decided rise of the temperature after tuberculin has been used, it becomes necessary, in order to make a diagnosis of tuberculosis, to exclude all other possible causes of a rise, — such as acute inflammation in any part of the body, excitement, excessive heat, etc. For this reason tuberculin is most valuable in the hands of those who are thoroughly conversant with the various diseases of cattle.

The use of tuberculin does not give any information as to the extent of the development or the rapidity of the progress of tuberculosis in cattle. It has been found that the reaction is fully as great in those animals in which there are but one or two small inert tuberculous nodules no larger than a buck shot as it is when there are extensive and active lesions. Consequently, in order to prove the accuracy of the tuberculin test, it becomes necessary to make a thorough examination in all autopsies, to detect the minutest nodules that may be present. In many cases this requires prolonged search and a knowledge of the gross and microscopical appearances of tuberculous tissue.

Following there appear the conclusions drawn from a series of experiments made with tuberculin at the Massachusetts Agricultural College. These are taken from Bulletin No. 27 of the Hatch Experiment Station, a few copies of which are still in the hands of the director for distribution.

1. That it is unsafe to purchase animals to add to a healthy herd from a herd in which tuberculosis has existed.

2. That poor sanitary surroundings, especially imperfect ventilation and insufficient light, are favorable to the rapid spread of tuberculosis among cattle.

3. That it is much better to dispose of excrement outside of stables than in cellars underneath them.

4. That mangers and other stable fixtures which increase the amount of surface, cracks and corners that cannot be easily cleaned are objectionable, from the fact that when the germs of tuberculosis become scattered, under such conditions they are not easily destroyed by the use of disinfecting fluids.

5. That infected stables bear close relation to the propagation of the disease.

6. That even by the use of strong disinfecting fluids it is very difficult if not impossible to rid an old stable of the germs of tuberculosis.

7. That the diagnosis in most cases of this disease by physical examination is impossible.

8. That in tuberculin we have an exceedingly delicate and reliable test for tuberculosis.

9. That tuberculin indicates the existence of tuberculosis in the lungs and other parts of the body when objective symptoms are absent, and when no germs can be discovered by microscopical examination of the mucus from the nostrils.

10. That its use is not followed by any ill effects of a serious or permanent nature.

11. That in some instances the injection of tuberculin produces a marked rise of the internal temperature when no tuberculosis exists.

12. That in some cases when tubercles are present in the body its injection is not followed by a well-defined reaction.

13. That the reaction following the use of tuberculin bears no relation to the extent or development of the disease.

14. That it is impossible to formulate a rule by which we can say that certain variations of the temperature may or may not indicate the presence of tubercles.

15. That in tuberculin we have the only means by which we can eradicate tuberculosis from among our cattle.

16. That our old-style and unsanitary stables, thoroughly infected with the germs of tuberculosis, make the complete eradication and suppression of this disease well-nigh impossible.

BIRDS AS PROTECTORS OF ORCHARDS.

BY E. H. FORBUSH, ORNITHOLOGIST TO THE BOARD.

Having had some opportunity during the last twenty years for observing the food habits of birds, I have become convinced that they destroy enormous numbers of insects. This conviction gives rise to the question, To what extent are birds useful to man in this respect?

The present paper is merely a partial record of the results of an attempt to foster and protect birds in an old and neglected orchard with a view to observing the effect of such a policy upon the trees. The orchard is so situated as to be a favorite haunt for birds. It forms part of an estate in Medford, Mass., lying near the southern border of the stretch of wooded rocky hills known as the "Middlesex Fells," a large part of which is now under the control of the Metropolitan Park Commission of Massachusetts, and is being administered as a forest reservation. The nearest estates on the east and west of the orchard are cultivated to some extent. There are other orchards in the immediate vicinity, and many large and fine shade trees. There are also on the estate in question many varieties of trees and shrubs. There is a small piece of woodland, covering perhaps an acre and a half, in which yellow pine predominates, the other trees being principally ash, oak and maple, some hickory and a few white pines. A lane running along the southern boundary of the estate is bordered on both sides by elms and poplars. A line of mulberry-trees near the lane affords tempting food for such birds as are fond of fruit in its season. There are also many wild cherries and berries of several varieties, together with half a dozen trees of cultivated cherries.

Among the trees, shrubs and vines found on the estate and which furnish food for birds in the shape of berries or seeds at certain seasons of the year are the *Berberis vulgaris* (common barberry), *Vitis labrusca* (Northern fox grape), *Rhus toxicodendron* (poison ivy), *Prunus americana* (wild yellow plum), *Prunus pennsylvanica* (wild red cherry), *Prunus virginiana* (choke-cherry), *Prunus avium* (English cherry), *Rubus occidentalis* (black raspberry), *Rubus villosus* (high blackberry), *Rubus idæus* (garden raspberry), *Rosa nitida* (wild rose), *Pyrus malus* (common apple), *Ribes rubrum* (common red currant), *Fraxinus americana* (white ash), *Morus rubra* (red mulberry), *Quercus alba* (white oak), *Quercus coccinea* (scarlet oak), *Pinus strobus* (white pine), *Pinus rigida* (pitch pine), *Tsuga canadensis* (hemlock), *Juniperus virginiana* (red cedar).

The orchard itself is a typical old orchard, such as is often found on small farms. It has suffered greatly from neglect. Two-thirds of the original trees have died or are in the last stages of dissolution. This is largely the result of neglect and improper pruning. Dead limbs and holes in the trees offer nesting places for the wren, woodpecker and bluebird.

For three years, from 1891 to 1893, inclusive, the trees were trimmed and cared for. They were sprayed or banded to protect them from canker-worms, and the "nests" of the tent caterpillar (*Clisiocampa americana*) were removed. The result was a scanty yield of apples from most of the trees. One or two bore quite plentifully.

In order to observe the effect of the feeding of birds in the orchard, no care was taken in 1894 to protect the trees. During that year the tent caterpillars were very numerous in the vicinity, and it became evident also that a great increase in the number of canker-worms was taking place in the neighborhood. Although these insects made considerable inroads upon the trees, they did not seriously injure the foliage anywhere except in one or two instances. No attempt had been made previous to the year 1895 to foster or encourage the birds in the neighborhood, except that a few nesting boxes were put up in 1894, which were occupied in one case by a family of wrens and in another by the English or house sparrow. We were careful, however, to destroy the nests of the house sparrow.

In the fall of 1894 it was noticed that immense numbers of the wingless females of the fall canker-worm (*Anisopteryx pometaria*) were ascending nearly all the trees and depositing their eggs; also, that the eggs of the tent caterpillar moths were numerous upon the twigs, promising a plentiful supply of caterpillars for 1895.

Having allowed the insects one year to increase unmolested by man, we began in the winter of 1894–95 to encourage the presence of birds in the orchard.

In 1894 a small tree in the centre of the orchard had been enclosed by a high board fence. The tree thus enclosed was used as an out-door experiment station for observations on the breeding and habits of the gypsy moth. During the winter of 1894–95, Mr. C. E. Bailey made frequent visits to this tree to ascertain whether or not the birds were destroying the eggs of the gypsy moth. Incidentally, Mr. Bailey observed the feeding of birds on the eggs, larvæ and pupæ of insects which winter on the trees, and I am greatly indebted to him for many interesting notes on the feeding of birds in this orchard. He is a careful, conscientious observer, and is intimately acquainted with most of our native land birds.

Hunters and trappers are aware that many species of winter birds, such as titmice, woodpeckers, crows, jays and nuthatches are attracted by a skinned carcass suspended from a limb, and will remain in the vicinity until all the bones are picked clean, or until, with the approach of spring, insect food becomes more accessible.

Believing from my own observations that the chickadees (*Parus atricapillus*) were feeding on the eggs of the fall canker-worm, I asked Mr. Bailey to attract the birds to the orchard by suspending pieces of meat, bone, suet, etc., from the trees. These food materials are suitable for insect-eating birds at times when the trees are covered with snow or ice, and when, lacking such nourishment, they might starve. Although birds will frequently visit bait provided for them and in time will eat a considerable portion of the meat, they do not depend entirely on this aliment, but spend the greater portion of their time in searching for insects and eggs in the immediate vicinity.

Finding a plentiful supply of food, the chickadees remained about the orchard most of the winter, except for a week or two, when the supply of meat was exhausted, but they were lured back again later by a fresh supply which was placed in the trees. Not only were the chickadees attracted to the orchard in large numbers, but other birds came also. A pair of downy woodpeckers (*Dryobates pubescens*) and two pairs of nuthatches (*Sitta carolinensis*) were frequent visitors, and a few brown creepers (*Certhia americana*) came occasionally. All these paid frequent visits to the meat and suet, and also thoroughly inspected the trees in search of insect food. They made excursions also to the trees in the neighborhood, but the greater portion of their attention was confined to the orchard in which the bait was suspended. As they became more accustomed to Mr. Bailey's presence, they grew quite tame and could be viewed at a distance of a few feet. Indeed, chickadees frequently alighted on his person and occasionally took food from his hand. He was thus enabled to determine accurately (without killing them) what they were feeding upon, and was soon convinced that they were destroying the eggs of the canker-worm moth in large numbers, as well as the hibernating larvæ and pupæ of other insects injurious to trees.

To determine how many eggs a single chickadee would eat, a few birds were killed and their stomach contents examined, with surprising results. There was no difficulty in identifying the eggs of the canker-worm moth which were found in the birds' stomachs, as a great portion of the shells remained intact. The other insect contents of the stomachs were identified for me through the kindness of Mr. A. H. Kirkland, B.Sc., assistant entomologist to the State Board of Agriculture, who made the examinations. Although it was impossible in all cases to learn with certainty the species to which certain insects belonged, it was evident that they could be referred to genera known to be of injurious habits.

I take the following from Mr. Bailey's notes : —

Number of Eggs of the Fall Canker-worm found in Stomachs of Chickadees.

No. 1,	273 eggs.
“ 2,	261 “
“ 3,	216 “
“ 4,	278 “

Making in all 1,028 eggs found in the stomachs of four birds. Four birds killed later in the season had eaten the female imagoes of the spring canker-worm (*Paleacrita vernata*) as follows : —

No. 1,	41 moths.
“ 2,	18 “
“ 3,	27 “
“ 4,	19 “

Making a total of 105. In Nos. 2, 3 and 4 of the last table there were a large number of eggs also. It is safe to say that there were 150 eggs in each stomach, in addition to the female moths eaten.

Mr. Bailey carefully counted the eggs in the ovaries of twenty of these female moths, with the following results : —

No. 1,	158	No. 11,	111
“ 2,	272	“ 12,	160
“ 3,	127	“ 13,	193
“ 4,	184	“ 14,	131
“ 5,	213	“ 15,	281
“ 6,	135	“ 16,	242
“ 7,	140	“ 17,	116
“ 8,	220	“ 18,	281
“ 9,	200	“ 19,	192
“ 10,	130	“ 20,	217

It will be seen from this table that the average number of eggs found in each moth is 185. Mr. Bailey is very positive, from his continuous field observations, that each chickadee will devour on the average 30 female canker-worm moths per day from the 20th of March until the 15th of April, provided these insects are plentiful. If the average number of eggs laid by each female is 185, one chickadee would thus destroy in one day 5,550 eggs; and in the twenty-five days in which the canker-worm moths "run" or crawl up the trees, 138,750. It may be thought that this computation is excessive, and it is probable that some of the moths were not captured until they had laid some of their eggs, but the chickadees were also busy eating these eggs. When we consider further that 41 of these insects, distended as they were with eggs, were found at one time in the stomach of one chickadee, and that the digestion of the bird is so rapid that its stomach was probably filled several times daily, the estimate made by Mr. Bailey seems a very conservative one. He now regards the chickadee as the best friend the farmer has, for the reason that it is with him all the year, and there is no bird that can compare with it in destroying the female moths and their eggs. It was noticed that the birds made no attempt to catch the male moths. This, however, cannot be considered as a fault, for the birds accomplish far more by destroying the females than they would by killing males.

The following notes from the preliminary examinations of the contents of the alimentary canal of a chickadee, made by Mr. Kirkland, are of interest in this connection: —

> Bird brought in by Mr. Bailey, March 16, 1895: Gullet empty. Gizzard contained 270 canker-worm eggs (*Anisopteryx pometaria*), 46 case-bearers (microlepidoptera), 6 cocoons of a small tineid (near *Aspidisca*). These three kinds of food in bulk composed 80 per cent of the gizzard contents, the remainder being dark material which I was unable to determine under a hand lens. I think it very probable that part of this was bits of bark or particles of bark-dust taken in with the eggs or cocoons. The intestine contained a large quantity of meat, 75 per cent, and 103 canker-worm eggs, 10 per cent; the remainder, 15 per cent, being material which I could not identify. It was not meat. This gives us as totals, 373 canker-worm eggs and 52 microlepidoptera.
>
> Specimens of so-called "scales" on apple twigs brought in by Mr. Bailey, March 12, 1895. These are not bark lice, but the cocoons of a microlepidopteron, probably a tineid. Length, $\frac{1}{12}$ to $\frac{1}{8}$ inch; width, $\frac{1}{12}$ to $\frac{1}{10}$ inch; elliptical, dark brown or reddish brown. They are closely spun, the upper surface apparently being of leaf epidermis, while underneath is a small, well-formed

cocoon which contains a minute green larva which evidently hibernates as such, probably pupating in the spring. The larva undoubtedly feeds on the leaves of the apple-tree, as these cocoons were taken from the small twigs at the extreme end of a large branch. Some of these cocoons are empty and have a minute hole at one end, which probably served for the egress of some small parasite. These cocoons are eaten by the chickadee, and have been found in the gizzards of the birds.

The case-bearers and the tineids or leaf miners are injurious to the foliage of the apple-trees.

It was noticed by Mr. Bailey, who watched the birds closely for several days, that they were eating quantities of both of these insects. It would have been impossible for any one to determine the species of the leaf miners as found in the birds' stomachs, for little remained but small fragments of the shell of the creatures. Mr. Bailey noticed that the birds were taking objects from the twigs, some of which they ate; others they rejected and dropped upon the snow. Some of those dropped he picked up and examined, finding them to be parasitized. The birds undoubtedly ate only those which were alive.

It was evident from a careful examination of the eggs found in the stomachs of the chickadees either that they were broken by the bill in such a way that the contents were exposed to the action of the gastric juice or that the gastric fluid destroyed a portion of the shell. Occasionally a few eggs which appeared to be whole were found in the intestines.

A great quantity of animal food is required to sustain life and provide animal heat sufficient to enable these little birds to resist the inclemency of our severe winters. In proof of this it may be stated that during favorable weather the birds visited the meat and ate largely of it three times each hour with fair regularity. During each interval they were occupied in destroying eggs and other hibernating insect forms which were always present and numerous in the stomachs examined. This feeding appeared to be almost continuous except in severe storms when the birds sought shelter or when they were laboring under excitement caused by fear, as in the case of a visit from a hawk, cat or shrike. Whenever a cat appeared they immediately hid behind the branches and remained quiet until the intruder had passed. The appearance of other enemies or the firing of a gun would produce much the same effect.

The woodpeckers and nuthatches which frequented the orchards were not seen to eat the eggs of the canker-worm moth. As they were not numerous, none were killed. Mr. Bailey observed, however, that the nuthatches were eating many scales which they found on the limbs of the apple-trees in a neighboring orchard. In relation to these scales the following note from Mr. Kirkland is of interest: —

> March 20, 1895. Mr. Bailey brought in specimens of apple twigs infested with the bark scale louse, *Mytilaspis pomorum*. He reported that the nuthatch was feeding on them. These twigs were infested in a worse manner than I have ever seen before. They were literally covered with the scales. On one small twig, one-half inch in diameter, I counted 367 scales on one inch of the twig. The eggs contained in a number of scales varied from 62 to 83, with an average of 70.

These scales, when numerous, are very injurious to the apple-tree. Each scale covered a dead female of the preceding year and the hibernating eggs, many of which must have been disposed of by the nuthatches. It was shown, both by observation and dissection, that birds feeding in the same neighborhood and upon the same trees showed considerable variance in the character of their food. Kinglets taken had no canker-worm eggs, but had eaten largely of bark borers. Woodpeckers seemed to confine themselves to the larvæ of borers and to wood-ants and other insects which bore into the wood of the tree. Chickadees and nuthatches ate the pupæ and eggs of insects found upon the bark or in the crevices of the trunks. No birds were seen to eat the eggs of the tent caterpillar, nor were any found in the stomachs of any of the birds examined. It seems probable that these eggs are so protected by a hard covering that they are not eaten by most birds.

It is impossible, in the limited space at our command, to give results of all observations and dissections in detail. We can merely give the apparent results of the presence of the birds in the orchard.

It was found that these birds were not only destroying the eggs of the canker-worm in this orchard, but were feeding on the eggs of the same insect in the woods where bait had been suspended.

As the frost left the ground on the first warm days of spring the wingless females of the spring canker-worm moth appeared in the orchard and began ascending the trees in great numbers. The chickadees commenced catching and eating the females and their eggs. Mr. Bailey placed twenty-two of the females on one tree, and in a few minutes twenty of them were captured and eaten by chickadees.

It was noticed as spring approached and insects became more numerous that the chickadees came very seldom to the meat. They were not as assiduous in their attention to the orchard, and a small portion of their food consisted of the early gnats which were flying on bright, sunny days. In early April they had nearly deserted the meat, although they still frequented the orchard in search of the female canker-worm moths. They seemed to prefer animal food to all other, and even in cold weather would hardly notice grain or seeds of any kind, though one individual ate a few oat kernels which were placed near his accustomed feed of meat.

Towards the last of April the English or house sparrow (*Passer domesticus*) began to make its appearance in the vicinity and apparently drove the chickadees to the woods, as they disappeared and did not nest in the orchard, but remained in the woods, where they paired and nested.

I believe that the English sparrow is largely responsible for the fact that chickadees are not now found nesting in our orchards. Though they still nest in the orchards on the remoter farms and in the villages where the English sparrow is not numerous, they seem to have disappeared in summer from orchards near cities. At the time of the advent of the sparrow in this locality, twenty-five years ago, chickadees were often found nesting in old apple-trees in the orchards in this region where now scarcely any are to be seen in orchards during the summer.

In the latter part of April and in early May the tent caterpillars made their appearance on the apple and cherry trees in the neighborhood. Canker-worms were also numerous on the apples and elms and appeared in some of the other trees. It was noticed, however, that, while trees in neighboring orchards were seriously infested with canker-worms and to a less degree with tent caterpillars, those in the orchard which had been frequented by the chickadees during the winter and spring were not seriously infested, and that comparatively few of the worms and caterpillars were to be found there.

With the warm south winds of May, many summer birds came and settled in the neighborhood, and prepared to build their nests, among which the following were seen: chickadee (*Parus atricapillus*), tree sparrow (*Spizella monticola*), crow (*Corvus americanus*), purple grackle (*Quiscalus quiscula*), flicker (*Colaptes auratus*), red-winged blackbird (*Agelaius phœniceus*), robin (*Merula migratoria*), chipping sparrow (*Spizella socialis*), oven-bird (*Seiurus aurocapillus*), wood thrush (*Turdus mustelinus*), catbird (*Galeoscoptes carolinensis*), brown thrasher (*Harporhynchus rufus*), black-billed cuckoo (*Coccyzus erythrophthalmus*), yellow-billed cuckoo (*Coccyzus americanus*), black and white warbler (*Mniotilta varia*), yellow warbler (*Dendroica æstiva*), chestnut-sided warbler (*Dendroica pennsylvanica*), black-throated green warbler (*Dendroica virens*), pine warbler (*Dendroica vigorsii*), house wren (*Troglodytes ædon*), American redstart (*Setophaga ruticilla*), Nashville warbler (*Helminthophila ruficapilla*), golden-winged warbler (*Helminthophila chrysoptera*), scarlet tanager (*Piranga erythromelas*), rose-breasted grosbeak (*Habia ludoviciana*), Baltimore oriole (*Icterus galbula*), blue-jay (*Cyanocitta cristata*), least flycatcher (*Empidonax minimus*), wood pewee (*Contopus virens*), phœbe (*Sayornis phœbe*), kingbird (*Tyrannus tyrannus*), and downy woodpecker (*Dryobates pubescens*).

It was noticeable that early in the season, when the webs of the tent caterpillar first appeared on the apple and cherry trees, the orioles attacked them and devoured a considerable number of the hairy young larvæ. A little later, when the canker-worms became more numerous, it seemed as if all the birds in the neighborhood were intent on eating canker-worms, neglecting to a certain extent the hairy caterpillars. The cuckoos, however, seemed to feed impartially on both the canker-worm and the tent caterpillar.

Birds from all quarters in the wood and swamp, orchard and field, flocked into the trees infested by canker-worms, and there spent a considerable portion of their time. In a short time the few canker-worms which hatched from eggs remaining in the old orchard were apparently eaten by birds, and the birds then directed their attention to the neighboring orchards, which were swarming with the worms. It soon became evident that these orchards would be entirely stripped of their leaves, while the old orchard retained its full foliage. Thus it was seen that the trees to which the chickadees had been lured during the winter had been so well protected that the summer birds were able to destroy the few remaining larvæ, while the trees at a distance from these contained so many larvæ that the birds were not numerous enough to dispose of them or to make any effective reduction in their numbers. This apparently demonstrated the usefulness of the egg-destroying winter birds, and showed the wisdom of attracting them to the orchard during the winter months. Not only did nearly all species of birds in the neighborhood flock to the trees infested by the canker-worms, but the chickadees living in their retirement in the woods came out to the orchards, flying some distance to procure canker-worms with which to feed their young, and making regular trips to the infested trees day after day.

On May 18 Mr. Bailey saw a female chickadee carry twenty larvæ to its nest. They were apparently all canker-worms but two, which were tent caterpillars. Of this he is quite certain, for he was within three yards of the nest to which the larvæ were taken. Later, on May 31, he noticed the chickadees feeding their young. It was evident that a large portion of the food consisted of canker-worms. The birds each made a trip to the nest about once in twelve minutes. The male and female came at nearly the same time and went away together. They went in the direction of an orchard infested by canker-worms. A few of the larvæ were dropped on the ground at the nest, and proved, on examination, to be canker-worms.

The crow was also observed feeding on the canker-worms.

On May 22 the birds had nearly all stopped feeding in the neighboring woods and were in the orchards feeding on canker-worms.

Early in June, when the remaining canker-worms had finished their transformations and retired to the ground, several species of birds were again noticed feeding their young on the tent and other hairy caterpillars. Of these, three species (both cuckoos and the Baltimore oriole) seemed to be the most useful. On May 17 a cuckoo was seen to take eleven caterpillars out of one nest. Mr. Bailey writes: —

> On May 10 a black-billed cuckoo came into a tree near me at 3 P.M. and sat there until 4.40 P.M., then he went straight to a tent caterpillar's nest. He looked it over for a short time and then commenced eating the caterpillars. He picked twenty-seven caterpillars out of the nest before he stopped. The bird ate them all and did not drop one. Then he went to the tree in which I believe he remained during the night, for on Saturday, the 11th, I found the bird in the same tree and in almost the same place at 5 A.M.

The orioles, chickadees and vireos often pecked the caterpillars to pieces and ate portions of them, seemingly feeding to a considerable extent on the internal organs. This being the case, it is quite evident that the stomach contents cannot be depended upon entirely to determine the character of the food of these birds, as no one is expert enough to identify the internal organs of caterpillars with such certainty as to determine the species to which they belong.

The following is a list of the birds seen feeding on the tent caterpillar: —

Crow (*Corvus americanus*), chickadee (*Parus atricapillus*), oriole (*Icterus galbula*), red-eyed vireo (*Vireo olivaceus*), yellow-billed cuckoo (*Coccyzus americanus*), black-billed cuckoo (*Coccyzus erythrophthalmus*), chipping sparrow (*Spizella socialis*), yellow warbler (*Dendroica æstiva*).

During the month of May an attempt was made to render the place as attractive to birds as possible. The undergrowth, which previous to 1894 had been trimmed out, was afterward allowed to grow, and in 1895 several low thickets had been thus formed; the mulberry-trees were stimulated by judicious pruning, and bore a considerable crop of early fruit which ripened in advance of the cherries, thus drawing the attention of the fruit-eating birds away from the cherries, as well as serving to attract them to the vicinity of the orchard. Ten nesting-boxes were put up for the wrens and bluebirds; but as the bluebirds were very rare this season, none came to the orchard. Two families of wrens, however, were reared in the boxes in place of one family last year. Nesting materials — strings, hair and straw — were hung in the trees and scattered about. Several marauding cats were killed, and an attempt was made to keep nest-hunting boys away from the neighborhood as much as possible. Thirty-six nests of birds were discovered in the neighborhood, as follows: —

Three red-eyed vireos, ten robins, four Baltimore orioles, three cuckoos, five chipping sparrows, three least flycatchers, two redstarts, two yellow warblers, two chickadees, two house wrens.

Of these all but three were destroyed, probably by boys, the nests being torn down and the eggs missing. The three which escaped destruction were two wrens' nests which had been built in boxes upon buildings, and a robin's nest in a maple-tree within ten feet of a chamber window. This wholesale destruction of nests discouraged several pairs of birds, and they disappeared from the neighborhood. Those remaining built new nests, and after a second or third attempt a few succeeded in rearing young. One nest of orioles escaped the general destruction, and the birds were busy for a long time carrying canker-worms to their young.

One of them was noticed to take eleven canker-worms in its beak at one time, and fly with them to the nest. The vireos warblers, chickadees, cuckoos, orioles and chipping sparrows were particularly active in catching canker-worms, and the English sparrow killed them in considerable numbers.

If the thirty-six pairs of birds whose nests were found had succeeded in raising their young, it is probable that they would have disposed of most of the canker-worms in the neighborhood. Five thousand of these larvæ are sufficient to strip a large apple-tree. One hundred and eight young would have been reared, had each pair of birds raised three. According to Professor Aughey's experience, sixty insects per day as food for each bird, both young and old, would be a very low estimate.* Suppose each of these one hundred and eight birds had received its sixty insects per day, there would have been 6,480 caterpillars destroyed daily. The destruction of this number of caterpillars would be enough to save the foliage and fruitage of one apple-tree. In thirty days the foliage of thirty apple-trees could have been saved, or 194,400 canker-worms destroyed. This does not include what the old birds themselves would have eaten.

In these observations the influence of insect parasites and predaceous insects has not been entirely ignored. Hymenopterous parasites were not seen to be numerous, and as it was a year when canker-worms were on the increase, it is not probable that these parasites would have been a prime force in reducing the numbers of the canker-worms had the birds not been present. Even had they been numerous they would have had little effect in checking the ravages of the canker-worm during the present year, as their interest is identical with that of the canker-worm, and they remain in its body until it has finished feeding, allowing it to defoliate the trees before completing their deadly work upon it.

We do not know to what extent such parasites are devoured by birds. This we could not ascertain without shooting the birds, which would have defeated our main object. No parasites of the tent caterpillar or canker-worm were found in the stomachs of the few birds which were examined.

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* First report United States Entomological Commission, 1877, page 312.

It is hardly safe to draw conclusions from observations so limited in their scope, but we may infer from what was observed that the egg-eating birds are of the greatest value to the farmer, as they feed almost entirely on injurious insects and their eggs, and are present all winter when other birds are absent. The summer birds which attack the larvæ are valuable also if they can be so protected and fostered as to become sufficiently numerous to do the work required. It is evident also that a diversity of plants, which encourages diversified insect life and assures an abundance of fruits and seeds, as an attraction to birds, will insure their presence. In this connection I wish particularly to note the fact that the mulberry-trees, which ripen their berries in June, proved to be a protection to the cultivated cherries, as the fruit-eating birds seemed to prefer them to the cherries, perhaps because they ripen somewhat earlier.

I believe it would be wise for the farmer to plant rows of these trees near his orchard, and it is possible that the early June berry or shad berry (*Amelanchier canadensis*) might also be useful in this respect. It is a handsome shrub or tree, flowering early in the season, and would be attractive at a time when other trees and shrubs are not in bloom.

At the present time, July 23, 1895, the trees in the orchard appear to be in good condition. They have not suffered from the slight pruning of their foliage which was effected by the few caterpillars and canker-worms which survived for a part of the season. The fruit is well set, and it now remains to be seen whether the birds will have any considerable effect in preventing the ravages of the codling moth. No other orchard in the neighborhood will produce any fruit this season, with one exception. The nearest orchard, situated directly opposite on the estate across the way, has not been ravaged by the canker-worms. This exemption is due principally to the efforts of the owner, who has banded his trees with tarred paper and has used tree ink faithfully and well upon the paper. He has also taken pains to clear the nests of the tent caterpillar from the trees. This orchard, being nearest to the one visited by the chickadees, was also an object of their attention, and this may account somewhat for the reduction of the pests in this place.

The record of these observations, incomplete as it is, is given for what it is worth as a contribution to the literature of this most interesting and important subject.

INSECTICIDES.

BY A. H. KIRKLAND, ASSISTANT ENTOMOLOGIST, COMMITTEE ON GYPSY MOTH, BIRDS AND INSECTS.

Insect attacks of various kinds are chief among the causes which hinder the successful development of crops, and, if neglected, too often set at naught the labors of the farmer or gardener. Thanks to the discoveries of modern science, we are now able in nearly all cases to find a means of checking these ravages by simple remedies if employed at the right time. A brief digest of our present knowledge of insecticides is given herewith, in the hope that, while it presents but little that is new, it may prove in some measure helpful.

The feeding habits of insects attacking the exterior parts of plants afford us a ready means of separating them into two general groups, — biting insects (various caterpillars, beetles, etc.) and sucking insects (plant lice, scale insects, etc.). The members of the first group devour the substance of the plant by means of their jaws, while those of the second group secure their nourishment by the aid of a slender beak inserted into the plant tissues. The substances to be used in the destruction of insects are determined in great measure by these feeding habits, and may in like manner be separated into two classes: first, internal poisons used against biting insects; and second, external irritants or contact insecticides employed in destroying insects of the second group. The desirable qualities of an insecticide of either class are: —

1. That it should kill quickly.
2. That it should not burn the foliage or otherwise injure the plant.
3. That it should be cheap enough to be of practical value.

In addition to these requisites an insecticide of the first class should be capable of remaining upon the foliage in an effective condition for a considerable period of time.

Various arsenical compounds have proved to be the most satisfactory internal poisons, those commonly used being London purple and Paris green. To these should now be added a third, arsenate of lead.

LONDON PURPLE.

This substance is a waste product in the manufacture of certain dyes, and contains a more or less soluble form of arsenic. Against leaf-feeding insects in general it is a very effective insecticide, but should be used with care, especially on trees with tender leaves (peach, plum, etc.), since burning of foliage often results from an application of too great a strength. One pound of the poison should be mixed with one hundred and fifty to two hundred gallons of water and applied as a spray. It can be purchased at retail for about fifteen cents per pound.

PARIS GREEN.

Paris green has been and is the farmers' favorite munition of war against the common insects of the first group. It retails at about twenty-five cents per pound, and is too generally known to need description. Professor Fernald of the Agricultural College at Amherst estimates that $76,000 worth of this substance is used annually in this State in combating the potato beetle. This poison can be applied in a variety of ways, according to the habits of the pest it is intended to destroy. A common and effectual way of applying it to potato plants to destroy the potato beetle, and one which I have often used with good success, is to enclose a quantity of the dry poison in a small bag fastened at the end of a short rod, and with it lightly dust the plants by holding the bag over the potato hills, at the same time striking the rod with a short stick held in the other hand. Sometimes burning of the foliage results from this treatment, and if used on a windy day there is presumably more or less danger to the operator from poisoning. Another excellent method for using the poison on low-growing plants consists in mixing one part Paris green with thirty to fifty parts plaster, ashes, or, perhaps best of all, wheat-middlings, applying the mixture to the plants by means of a sieve early in the morning before the dew has dried off. This forms a slight paste which causes the poison to adhere to the foliage for a considerable period. Probably the oldest and most common method of application to both plants and trees is the mixture of Paris green suspended in water and applied as a spray. This method, like the others, does not eliminate the danger of burning the leaves when the mixture is too strong, but to do the most effective work it is good policy to use the mixture as strong as possible without causing serious injury to the foliage. Experiments have shown the average burning point to be below the proportion of one pound of Paris green to one hundred and fifty gallons of water. The addition of lime to the mixture is recommended by some entomologists. This is thought to neutralize the small amount of free arsenious acid in the Paris green, thus preventing in some degree the danger of burning the foliage. Care must be taken, however, not to add too great a quantity of lime, nor allow the mixture to stand for any considerable period of time, since otherwise a more soluble compound and one of greater burning powers will be formed.

Arsenate of Lead.

This new insecticide, which was discovered by Mr. F. C. Moulton while experimenting under the direction of the State Board of Agriculture in connection with the work of exterminating the gypsy moth, has proved so far to be the best of any of the arsenical compounds. It may be prepared by mixing approximately thirty parts by weight of arsenate of soda dissolved in water with seventy parts acetate of lead also dissolved in water. As a result of the chemical reactions which take place, arsenate of lead is thrown down as a finely divided white precipitate which readily remains suspended in water. This poison may be purchased in bulk in the market at about fifteen cents per pound. Weight for weight it does not appear to be as effective as either London purple or Paris green, but since it will not burn the most delicate foliage when used at a killing strength it is pre-eminently the best insecticide of the class. Notwithstanding the fact that the poison has not proved all that was hoped for it when used against the gypsy moth, — since a large proportion of the caterpillars of this remarkably hardy insect have been known to feed unharmed on foliage sprayed with great strengths of the poison, — it has proved very effective against ordinary insects and its use is to be highly recommended. It can be safely applied to plants either clear or mixed with plaster, middlings, etc., as in the case of Paris green, or used on both plants and trees as a spray when mixed with water at the rate of two to four pounds to one hundred and fifty gallons. Twenty pounds to one hundred and fifty gallons of water have been used in many experiments against the gypsy moth without apparent injury to the foliage. Another advantage of this poison is that it leaves a faint white coating on the foliage, thus indicating the places sprayed. I have seen trees that were sprayed in June and yet showed the coating plainly in August.

The chief value of arsenate of lead, however, lies in its insolubility in water, which obviates the danger of burning the foliage. This has always been the principal objection to the use of arsenicals, since foliage "burned" soon falls to the ground, and a tree thus deprived of its leaves in the middle of a season is of course unable to ripen its fruit or successfully complete the year's growth of wood, and, in addition, is materially injured by the exhaustion of the reserve force necessary to produce the second crop of leaves which most species of deciduous trees bring forth when defoliated early in the season. Thus the damage to the tree from "burning" is often as great as that from defoliation by insects. The burning effect of arsenical poisons on leaves depends on the destruction of the living contents (protoplasm) of the cells which make up the leaf, as is shown by the illustrations which follow.

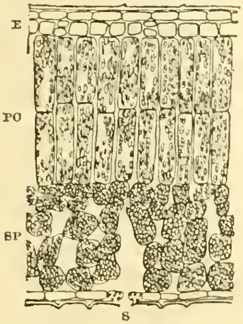

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FIG. 1 (original). Section through normal leaf of pig-nut hickory (*Carya porcina*), showing structural elements. E, epidermis; PC, palisade cells; SP, spongy parenchyma; S, stoma or breathing pore.

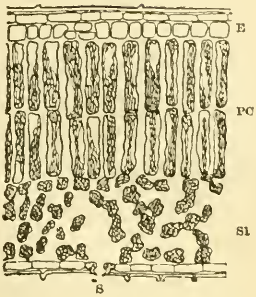

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FIG. 2 (original). Section through leaf of same tree, "burned" by excess of Paris green. Cell contents (protoplasm) of palisade cells and spongy parenchyma dead and dried up; cell walls shrivelled.

HOW TO USE THESE POISONS AGAINST COMMON INSECTS.

Spraying with a force pump is the best method of applying these poisons to trees. It is well to add from two to four quarts of glucose or cheap molasses for every one hundred and fifty gallons of the poison mixture used, as this causes the poisons to adhere to the foliage. To destroy the bud moth (*Tmetocera ocellana*), spray when the buds begin to swell; against the codling moth (*Carpocapsa pomonella*), spray just after the petals have fallen from the blossoms. The tent caterpillar (*Clisiocampa americana*), the cankerworms (*Anisopteryx pometaria*, *Paleacrita vernata*), as well as the tussock moth (*Orgyia leucostigma*) and the elm-leaf beetle (*Galeruca xanthomelæna*), can be cleared from infested trees by one or more thorough sprayings soon after the insects make their appearance.

CONTACT INSECTICIDES.

Against insects of the second group previously mentioned (*i. e.*, sucking insects) a different means of attack must be employed, for, as they do not take in solid nourishment, a poison applied on the foliage or stems, as in the case of arsenic compounds, would be of no value. From the nature of their feeding habits they are not as active as the biting insects, and often remain fixed in one place for a long time, thus rendering their destruction easy through those insecticides which kill by contact. The general effect of contact insecticides is to suffocate the insects by closing the breathing pores, either by coating them over with a film or inducing an irritation which closes them. The most practical and hence most prominent insecticide of this class is kerosene emulsion, the formula for which as given by Professor Fernald is presented herewith: —

> *Kerosene Emulsion.*
>
> This most useful insecticide is prepared in the following manner: One-quarter of a pound of common bar soap is dissolved in two quarts of boiling water, and while still hot four quarts of kerosene oil are added and the whole mixture churned through a small hand force-pump with the small nozzle turned into the pail. This churning must be continued about five minutes, until the whole forms a creamy-white mass which becomes jelly-like when cool. Care must be taken to have the soap solution *hot* when the kerosene is added to it and the churning done, but it must not be near a fire.
>
> Before applying the emulsion to plants it should be diluted with water in the proportion of one quart of the emulsion to nine quarts of water, which must be thoroughly mixed. The above will make sixty quarts of insecticide ready for use, but the emulsion will keep for a long time without injury and may be diluted at the time of using. This insecticide is said to be one of the best substances for the destruction of vermin on domestic animals and in hen houses.

The dissolving of the soap requires considerable time, and I find that the emulsion when needed for immediate use may be prepared more expeditiously and equally as effectively by use of the same or a little greater quantity of any good soap powder in place of the bar soap. The common soap powders readily dissolve in hot water, thus obviating the necessity of cooking the mixture over a stove, and so far as I have observed make an excellent emulsion. Samples prepared four weeks ago are as permanent as when made, and I see no reason why they may not keep as well as the emulsion made with hard soap. Their killing properties are equally as good and they do not damage the foliage. Kerosene emulsion is an invaluable remedy against nearly all plant and bark lice, and for this purpose it should be applied as a spray.

Raupenleim, Etc.

Another class of insecticides, or perhaps more properly "insect-traps," includes the various mixtures for banding trees to prevent the ascent of injurious insects. Chief among these are coal tar, printers' ink and the German Raupenleim ("insect lime"), or, correctly, caterpillar-glue. When gas tar, printers' ink or a mixture of the two are used a tight-fitting band of tarred sheathing paper should be first tacked around the tree and the substance spread on the band, thus avoiding injury to the bark. With Raupenleim as ordinarily used there is not much danger of injury. Before applying it the trunks of the trees should be scraped smooth at the point on which the band is to be placed. The substance is a German preparation whose composition is a jealously guarded secret. It has been used by the State Board of Agriculture with fairly good success against the gypsy moth for two seasons, but as it was not found to meet all the requirements of the work its use was discontinued. It is apparently the product of some mineral oil. Prof. John B. Smith, entomologist of the New Jersey Agricultural Experiment Station, who has kindly placed at my disposal the notes made on a series of experiments with this substance, finds that, aside from its value in stopping the passage of insects up and down trees, it has also proved an excellent means of preventing borers from laying their eggs on tree trunks. Against the sinuate pear borer, which has caused considerable damage to orchards in New Jersey, Professor Smith found it to be a most successful preventive when properly applied. For this purpose it was applied in a coat three-sixteenths of an inch thick over the whole trunk of the tree as far as the lower branches.

For use against the canker-worms apply the Raupenleim in a band one-fourth of an inch thick and three to four inches wide around the tree. The Raupenleim may be put on with a paddle and spread with a stiff brush. The bands should be put on the trees about October 1 and freshened the following spring. If left on during the summer these bands will prevent such trees as have been properly cleaned of the eggs of the tussock moth from becoming infested with the caterpillars of this insect. Raupenleim may be purchased in the market at from ten to fifteen cents per pound, according to the quantity desired.

At the suggestion of Professor Smith, Prof. F. L. Nason of the New Jersey Agricultural College, New Brunswick, N. J., has conducted a series of investigations concerning the composition of Raupenleim, and has at last succeeded in preparing a substance almost identical with the foreign product. Professor Nason's compound is known under the name of "dendrolene," and is nearly if not quite as effective as the Raupenleim. It may be purchased at about six cents per pound, and is well worth a trial in protecting trees against canker-worms.

While this paper is intended to treat of insecticides rather than insects, a few additional words concerning the application of some of these methods in combating the canker-worm and tussock moth may not be inappropriate, since these insects have been unusually abundant in many parts of the State this year.

The apple orchards of eastern Massachusetts were, as a rule, seriously damaged by the canker-worms, and in some orchards the fruit crop was almost a failure from this cause. The ravages of this pest can be obviated by banding the trees with Raupenleim or tar, as already indicated, to prevent the ascent of the female moths.

The canker-worms being of two kinds, fall and spring, this work should be done early in the fall and the bands kept fresh up to the time severe cold weather sets in, and should also be put in working order with the advent of warm weather in the spring. The wingless female moths ascend the trees on warm days to lay their eggs, and the same weather that will bring them out will also soften the bands — if they have been properly put on — and make them sufficiently adhesive to catch the moths.

The value of the presence of chickadees in orchards has been ably demonstrated by the ornithologist of the Board, Mr. E. H. Forbush, in a recent bulletin. These birds, as has been pointed out by Mr. Forbush, destroy immense numbers of canker-worm moths and eggs, and may be made to frequent orchards by placing meat, bones, etc., in the trees during the winter. Where these precautionary measures have been neglected and the canker-worm larvæ appear in the trees, spray promptly and thoroughly with arsenate of lead, as directed.

Against the tussock moth, which has caused so much damage this year to parks, street trees and even small orchards in Boston and the suburban district, as well as elsewhere in the State, somewhat different methods should be employed. The present year * the pest devastated many fine elms on Boston Common and stripped and in some cases seriously damaged numerous street trees. Many horse-chestnut, elm, pear and cherry trees stripped in midsummer by this insect in Boston, Chelsea, East Boston and Charlestown have been unable to throw out a second crop of leaves (like the linden) and are as bare as in winter. To prevent the ravages of this pest in the cheapest and most efficient manner the infested trees should be thoroughly cleaned of the nests in the winter when the branches are bare. These nests, from their white, frothy appearance, are readily seen and easily removed. Where they occur in crevices in fences and in other places difficult of access, they may be destroyed by the use of crude mineral oils. After the larvæ hatch, trees where they are most abundant should be heavily sprayed with arsenate of lead wherever it is practical to do so. In the same way, so far as possible, trees which have been cleared of nests should be isolated from infested trees by means of Raupenleim or other suitable bands, those in public places being put on at a sufficient height from the ground to prevent injury to the clothing of passers by. These methods, if thoroughly enforced, will reduce the numbers of the pest in localities where employed to a point where it will do no particular damage.

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* 1895.

HINTS ON LAND DRAINAGE.

BY WM. WHEELER, ENGINEER TO THE BOARD.

All plants with which agriculturists and horticulturists concern themselves are air plants, in that their roots are dependent upon air in the soils in which they grow. Consequently the available depth of any soil for agricultural purposes is practically limited to the depth to which air can penetrate it, and cannot exceed, therefore, that part of it which is above the water table, or the level at which water of saturation stands in the ground.

Effects of Land Drainage.

It is the primary object of artificial drainage, then, to increase the effective depth of soils and to improve their general character by lowering the water table in or under them. Among its benefits and advantages are the following: —

First. — It increases (with the aid of the deeper cultivation permitted thereby) the amount of soil space and material for the root-feeding of plants and for bacterial action and other agencies in vegetable nutrition.*

Second. — A greater proportion of the rain and snow water leaches through and surrenders to a well-drained soil the elements and agents of plant nutrition which such waters transfer from the atmosphere to the soil, and, as a further consequence, the washing away of the soil by the flow over its surface is reduced.

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* The degree of moisture has a marked influence upon the activity of the micro-organisms of the soil which aid in the nutrition of plants, especially the root-tubercle bacteria and bacteroids, through which leguminous plants, such as lupines, beans, clovers, alfalfa, etc., assimilate or fix free nitrogen from the air.

Experiments by E. Gain indicate that the development of such tubercles is about twenty times greater in moist soil than in dry soil, with a corresponding increase in the assimilation of free nitrogen They also lead to the conclusion that a medium amount of moisture in the soil (fifty per cent of that required for complete saturation) is more favorable to the development of root tubercles than higher or lower amounts. (United States Experiment Station Record: Vol. V., pages 110–113; Vol. VI., page 870.)

Third. — It affords also a *quicker* escape of the water falling thereon, thus shortening the time during which the soil is saturated with moisture and increasing the time during which it is aerated in a condition most favorable to plant growth.

Fourth. — Plants rooted in a deep soil are better able to withstand drought, chiefly by reason of the fact that beyond certain depths the evaporative power of sun and wind does not extend to an effective degree, whereby a drought that may be ruinous where, for want of drainage, the soil is shallow, may have little effect upon a deep, well-drained soil.

Fifth. — The capillarity of clayey soils — that is, the quality by which they absorb and lift water from below and convey it upwards to the roots of plants (as a wick lifts oil from the body of a lamp to the flame at its upper end) — is increased or quickened by deeper cultivation and root action therein.

Sixth. — Considerations of color, texture, material and exposure or direction of slope tend to modify somewhat through evaporation the physical character of soils as affected by drainage; yet as a rule a deeply drained soil is more uniform and constant in its moisture conditions or humidity than is a shallow one; and it may be accepted as an axiom that variation in humidity decreases as the depth or thickness of the aerated soil increases.*

It has been usually held that a drained soil better withstands drought, because it absorbs or receives air more freely into its interstices or pores, and extracts therefrom by chemical and physical action the water which such air contains. This theory I deem untenable and inadequate to explain the superior capacity of well-drained soils to withstand drought. The true explanation is to be found, I doubt not, in the greater penetration of the roots to depths less affected by drought and in the increased power of the deeper soil to obtain moisture by capillary attraction from below.

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* E. Wollny, United States Experiment Station Record, Vol. VI., page 858.

The insufficiency of aeration alone to supply moisture in amounts large enough to sustain ordinary vegetation is often shown by drained peaty soils, which, though of the most porous and absorbent nature, are not only incapable, during seasons of prolonged drought, of acquiring moisture by aeration (absorption from the air above), but are equally incapable of receiving it by capillarity (absorption from the water table below). The difficulty with such soils is that the size of the pores is so large and their volume so great that, while permitting the greatest possible degree of aeration, they are incapable of lifting water to a sufficient height by capillary attraction, and so remain dry. The same is true of soils composed of or underlaid by *coarse* sand or gravel. They too admit of the highest degree of aeration, but have little capillary power; whence it appears that it is the extremely porous soils of whatever material — that is, those best adapted for aeration — that suffer most in time of drought.

Well-drained soils, then, are not so effectively benefited in a dry time through the moisture which they absorb from the air as through that which they permanently retain below the effective action of evaporation and above the water table, supplemented by that absorbed from below through capillary attraction.

Such soils, whether too exclusively of peat or of coarse sand, may be improved by processes which tend to compact them so as to reduce the size and volume of their pores, thus diminishing aeration and increasing the moisture obtained by capillary attraction. In the case of well-drained peat soil *heavy rolling* after sowing or planting is often an effective aid to the germination of the seed. In dry times grass seed sown on such land will often be found to sprout and grow in the deep foot-prints of men and horses, while elsewhere no growth may appear until copious rain has fallen. Another method is by increasing the compactness and weight of peat by adding to and mixing with it either fine sand, clay or marl, or a combination of them, which will also improve its general chemical and physical qualities; while the excessive porosity of sandy soils may be improved by the application of clay or marl and decomposed muck or peat, the fine particles of which, filling the coarser pores of the sand, tend to retard evaporation and to promote the absorption of water from below.

How to drain Land.

Under-drainage works *can*, and if rightly done *will*, be, strictly speaking, *permanent* improvements. The construction of farm buildings, roads, walls and fences, though usually classed as such, are of a transitory and ephemeral character, compared with a well planned and thoroughly executed system of tile drainage.

That a drain may be permanent in its life and action, it must be so planned and constructed as to *let the water in* and *keep the silt* or earthy matter *out*. An open ditch may do the first admirably for a time, but soon fills up with the undermining and caving-in of its banks, and by the in-washing of loam and organic matter by the flow of surface waters into it. A stone or "blind" drain may admit water freely for a time, and conducts it fairly well where a considerable inclination or fall to a suitable outlet is practicable; but when laid (as such drains usually must be) in earth made up of fine particles it is liable to become clogged by the infiltration of silt.

Such drains can be made silt-proof, and consequently permanent, by enclosing or surrounding them with silt-excluding materials, such as boards (for a foundation), green brush, turf, old hay or straw, coarse gravel, etc., according to availability and other circumstances, which will readily suggest to the user the best of such means at his disposal.

Practically, however, where the main object is thorough drainage, and not the clearing up of stone or brush (and in most cases, even where such clearing is collaterally or contingently desirable), tile drains are superior to any other kind, because: —

They cost less in the sum total of labor and material.

They admit of being laid at flatter grades, and therefore of draining larger areas of level lands to an outfall of limited depth.

They are easily examined (through silt-wells), and imperfections or stoppages may be thus approximately located for repair or removal.

They are more durable, and, properly laid and cared for, are practically permanent in their life and operation.

There is a popular impression that ground water enters a tile drain through the porous bodies of the tiles themselves. This is essentially wrong. Indeed, the best tiles are those that are uniformly hard-burned to such a degree (just short of vitrification) that nearly all physical porosity has disappeared. In point of fact, at all times, excepting when the amount of water seeking to enter a drain exceeds its maximum capacity when running full, the water enters at the bottom of the *joints* and at the sides, as far up only as the surface of the stream flowing in and through the drain. One should not be tempted, therefore, to purchase tile for which is claimed the virtue of admitting water through the porous material comprising them, as such porosity serves no practical purpose, and can result only from insufficient burning, with consequent want of durability.

The joints of any land tile (however accurately moulded, however well their shape may be retained in the process of burning, and however closely fitted in laying) afford not only ample but practically the sole means for the admission of water from the soil around them. Indeed, the key to success in tile drainage, after securing a suitable outfall and adequate grades leading down thereto, lies in making such close-fitting and well-protected joints at the abutting ends of the tiles that clay and fine sand cannot be carried into the drain by the water as it enters through the joints. The subsoils of lands which best repay drainage are usually composed so largely of clay, or of very fine sand with or without a clay admixture, that not even the closest joints that can be made are thin or close enough, without special protection, to prevent *some* silt being carried into the drain, whence it becomes necessary to provide further means to prevent the entrance of such particles. This is usually done by laying a strip of tarred paper, oil cloth or heavy burlap (about an inch and one-half wide for small tile and two inches or more for the larger sizes) over the top and sides of each joint, in close contact with the outer surface of the tiles. Strong, tough turf, with most of the soil shaken out, may be used for the same purpose.

In quicksand especial care must be observed to lay and keep the tile in their proper grade and line, which may best be done by first placing and securing in the bed of the trench, at the true and established grade of the drain, a strip of board or plank about two inches wider than the outside width of the tile itself. At each joint of the boards a splicing piece about twenty inches long should be laid along the under side of the abutting ends of the boards, and both boards nailed thereto. Upon this continuous foundation the tile are to be laid in a true line, and where further security against lateral movement is required ordinary lath may be placed on edge along and against each side of the tile, the joints being first covered with strips of tarred paper or other material, as above described. In back-filling the trench the coarsest material that is available should be first used in contact with the tile, the constant purpose to be kept in view being to keep the quicksand out of the joints by placing around the tile such material as will permit the admission of water only.

Where gravel or coarse sand may be easily and cheaply obtained, one of the best methods of laying tile in quicksand or soft clay is to excavate the trench three or four inches below grade, and fill up to the grade with gravel or coarse sand; then lay the tile upon the gravel bed in the usual manner, cover them with the same material to a depth of three or four inches, and complete the back-filling of the trench as before, with the coarser material toward the bottom. The result is a tile drain laid in a material not easily displaced by external influences, and surrounded by a continuous filter which will admit water with the utmost freedom and exclude silt. Where the cost of obtaining such coarse material is large, its use may be confined to surrounding the *joints* only, to a distance of two or three inches; but a more thorough and permanent work will be insured by bedding and covering the entire tile with it.

Under-drains should be deep enough to encourage the fullest development of root growth, to avoid any disturbing and integrating effects from freezing and to escape the danger of being obstructed by roots entering at the joints. Lowering the water table much below the greatest depth of root action diminishes the moisture raised by capillarity, and is therefore disadvantageous. Subject to these considerations and to such variations as the necessities of the grade of the drain and the inequalities of the surface of the ground may involve, from three and one-half to four and one-half feet is a fair average depth to adopt. Less may be used where a low or deep out-fall cannot be had, as in the case of flat lands situated at a slight elevation above an adjacent pond or stream which fixes the level at which the main drain may discharge.

The distance between drains is governed chiefly by the greatest depth, within the limits already stated, at which they can be laid, and by the permeability of the soil and subsoil to be drained thereby. In clayey soils, through which water percolates but slowly and with the greatest difficulty, the drains should be placed at a distance of about six to seven feet for every foot of their depth; while for loamy soils, underlaid by sand, equally good drainage may be secured if the drains are laid at nearly double that distance apart, or ten to fifteen feet for each foot of depth, depending upon the porosity of the underlying material. Thus in clay or hard-pan drains three or four feet in depth should be laid from twenty to thirty feet apart, and for soils underlaid by sand the distance (for the same depth) may be forty or fifty and sometimes sixty feet, while in material of intermediate character or porosity a distance of thirty to forty feet would be suitable.

Without discussing the various considerations affecting the sizes of tile to be used, it may be said that one thousand feet laid forty-five feet apart will drain an acre of land underlaid by a permeable soil, and that the maximum amount of ground water collected and discharged thereby would rarely exceed the full capacity of a two-inch tile with round bore, laid at such a grade or fall that the water flowing through the same will carry along such fine silt as may unavoidably enter at the joints, say not flatter than three to four inches in a hundred feet. With a fall of six inches in a hundred feet the same size of tile will carry the water collected by about fifteen hundred feet of drains, and will therefore be sufficient for an acre and one half of land; while with a fall of twelve inches in a hundred feet two-inch tile will serve about two thousand feet of drains, or two acres of porous land.

In clayey lands less of the rainfall percolates into the soil, consequently drains therein will receive a smaller quantity of water per acre, which in ordinary practice may be assumed to be about one-half as great as that in lands underlaid by free water-bearing sand. Therefore the same size of tile or capacity of main drain will suffice for about double the area of clayey subsoils that would be needful for sandy subsoils; and, inasmuch as the drains should be placed at about one-half the distance in clayey soil, it follows that the amount or length of drain that may be discharged through a two-inch tile for such lands is about four times as great as in those having a free subsoil. Thus, while a thousand feet of two-inch tile, laid forty-five feet apart in a free subsoil, will serve one acre, four thousand feet of the same size, laid twenty-two and one-half feet apart, will serve two acres of clay land.

The relative capacities of different sizes of tiles are approximately as follows, that of a two-inch tile being indicated by 1, to wit: —

Capacity of two-inch tile equals, ...	1.00
Capacity of two-and-one-half-inch tile equals, ...	1.50
Capacity of three-inch tile equals, ...	2.50
Capacity of four-inch tile equals, ...	5.00
Capacity of five-inch tile equals, ...	7.50
Capacity of six-inch tile equals, ...	12.50
Capacity of eight-inch tile equals, ...	25.00

Thus for land requiring two-inch tile to carry the maximum drainage from one acre, a main drain of four-inch tile will serve five acres, one of six-inch tile twelve and one-half acres and one of eight-inch tile twenty-five acres. These sizes may be considered suitable for the areas stated, where the fall is not less than three, or better, four inches per hundred feet in main drains or laterals. Where the fall is twice as much, or not less than six inches per hundred feet, the same sizes will suffice for fifty per cent larger areas; and in general for clayey soils, with the same inclination as in free soils, tile of a given size will serve double the area.

Larger tile than are absolutely necessary to carry the maximum amount of water to be discharged through them make an inferior though more costly system of drainage, — inferior, because the velocity of flow is slower through tile of larger bore, consequently any silt which enters is more certain to be deposited in the tile and to gradually fill it up.

The flattest grade at which tile drains should be laid should be sufficient to insure a perfect scour, — that is, the carrying along by the water flowing therein of all silt which may enter at the joints. With care in laying at true grade, a fall of three inches in a hundred feet is as little as may be safely adopted for two-inch tile, and where the topography or surface contour allows, steeper grades should be used. Where the declivity is very great, as upon the springy sides of many New England hills of hard-pan, the lateral drains should as a rule run diagonally with the slope, instead of in the direction of most rapid descent, so as to more effectually cut off springs and underground water veins, which otherwise might appear at the surface between the laterals.

The larger the volume of the flow, and consequently the greater the size of the drain to carry it, the flatter may be the grade at which it may safely be laid. Thus, while the fall of two-inch and three-inch drains should rarely be less than three inches per hundred feet, a four-inch drain may with equal safety have a fall of two and one-half inches only, and six-inch and eight-inch drains of two inches per hundred feet. It should be borne in mind, however, that an obstruction in a large or main drain is a much more serious matter than in a lateral, and consequently such flat grades should be permitted only in cases of actual necessity.

LAYING OUT AND CONSTRUCTION OF DRAINS.

The laying out of drains, especially at flat grades, can be properly done only with the aid of accurate levelling instruments, which work can be done by an engineer or surveyor of ordinary skill and capacity. The expense of such services is trifling, compared with the facility, convenience and certainty of successful results thereby insured in the work.

The following suggestions may aid in laying out and constructing the work.

Having secured the proper outlet for the main drain, mark the position of all mains and laterals by driving into the ground at each end of each line, and also at every point where there is a change either in grade or direction, a grade peg or hub level with the surface. Beside it drive a reference stake, leaving one foot exposed, and mark thereon the depth at which the drain is to be laid below the top of the peg.

Upon opposite sides of each peg, across the line of the drain and far enough to clear the trench, drive two stakes firmly into the ground, leaving two or three feet out, and at some uniform height above the established grade of the drain nail across each pair of stakes a batter board made level from end to end, and mark thereon the centre line of the trench by a nail or notch in the upper edge plumb over the peg. Assume, for example, that all the batter boards are to be set at the uniform height of six feet above grade. If the cut or the depth of the trench marked on the reference stake at the lower end of any given drain is 4.25 feet, then the batter board must be placed 1.75 feet above the peg; and in like manner, if the cut at the next peg on the same line is 3.8 feet, the batter board must be set 2.2 feet above it. Thus the lines and grades of the entire system are established and fixed safe from disturbance during the execution of the work.

In digging the trenches, begin at the outlet or lower end of the main drain and work up grade, thus giving the water encountered in the work a chance to run off without pumping. It is usually better also to lay the tile in the same order, especially if the quantity of water is large and the trenches liable to cave. Throw the surface soil upon one side of the trench and the undersoil upon the other; and in refilling restore the different materials to their proper places, observing that the filling immediately around the tile should be of the coarser materials best adapted to exclude silt.

Make the trench no wider than is necessary for the convenience of the workmen, say from twenty to twenty-four inches at the top and from five inches upward at the bottom, according to the size of the tile. Excavate to the proper grade, and dress the bottom of the trench accurately by using a levelling rod or pole having a target or conspicuous mark thereon at the same distance from the bottom of the rod as that at which the batter boards are placed above the grade line. Test the depth of the trench frequently as the work progresses, by having one man hold the rod vertically in it while another sights over the top of the two batters nearest thereto, to determine whether the target or mark thereon is in the same line with the batters. Where the target stands above the line of the batters, the trench must be deepened; while if it stands below the line the trench is too deep, and must be refilled with material firmly packed until the target is in the same grade with the batters, with the rod standing on the bottom of the trench. Constant care and watchfulness should be exercised to avoid digging below the proper grade, as a natural bed that has not been disturbed furnishes a better and more secure foundation upon which to lay the tile.

Of the various forms of tile in the market, that known as "Ohio" or "Ohio land" tile is among the best. The bore is circular in cross-section, while the outside is polygonal (either hexagonal or octagonal). They have the advantage, therefore, of six or more sides or beds upon which they can be laid. All drain tile, however carefully made, are liable to be warped or curved in drying and burning, whereby with but one bed upon which to lay them many of the joints are certain to gape open upon one side or another, and thus admit silt more readily. A tile, however, which can be laid upon any one of six or eight different sides can be turned and tried upon all of them until a close joint is secured.

"Sole" tile of the same nominal size has less capacity, because the bore is elliptical, and its size is designated by its longer diameter. It has, moreover, only one bed, and hence it is impossible to make so good joints in laying it. "Round" tile have the same capacity as "Ohio," but, having no flat surface upon which to lie, they are less stable in the trench before covering, and therefore more liable to be thrown out of line in backfilling. In the Boston market both round and sole tile are somewhat higher in price than the Ohio tile.

Silt basins should be placed at the intersection of laterals with main drains and at all points where there is a change in direction, also where there is a change from a steeper to a flatter grade. A simple method of making a silt basin is by placing a vitrified sewer pipe of ten inches or greater diameter vertically, or upon end, in the line of the drain or drains leading into and from it. The bottom of the pipe should rest upon a plank or flat stone about a foot below the drain, and with the bell end upward. Lead the drains into and out of it through holes of proper size cut in the sides of the pipe at their proper level. In the bell at the top of this pipe set another of the same size, and so extend the silt basin either up to the surface of the ground or to within about a foot of it, according as it may be more desirable to cultivate over it without obstruction, or to have it always accessible for inspection and cleaning out without digging. Where it is to be covered, the top should be closed by a circular cover of plank or stone set in the upper bell end, and its location marked by a stake driven beside it, so that it may be occasionally uncovered and cleaned out so long as there shall continue to be any accumulation of silt in it. Where the silt basin extends to the surface of the ground, small animals and foreign matter should be excluded in a similar manner by a cover of wood, stone or iron, fitted and set into the bell of the pipe.

It goes without saying that the best time in which to construct a system of land drainage, other conditions being equal, is during seasons of long-continued drought, such as have occurred during the open season of 1894 and up to the present time this year. Then the level of the ground water, or the water table, is reduced to its lowest natural limits, and the work can be carried on at less cost and done in a more thorough manner by reason of the absence of water. Moreover, as a rule, the drains may be laid at a greater depth at such times than when the ground is full of water.

THE SAN JOSÉ SCALE.

(*Aspidiotus perniciosus* Com.)

BY PROF. C. H. FERNALD, ENTOMOLOGIST TO THE BOARD.

History and Distribution.

The San José (Sän Ho-sā′) scale insect first made its appearance in California not far from 1870, but it is not known from what country it came, though it is now known to occur in Chili, Australia and Hawaii. It increased rapidly till 1873, when it had become so abundant on the fruit trees at San José as to seriously injure them, and received the common name of the San José scale.

It was first technically named and described from Santa Clara County, California, by Prof. J. H. Comstock, in the report of the Department of Agriculture for the year 1880, page 304, under the name *Aspidiotus perniciosus*, "The Pernicious Scale." After describing it, Professor Comstock says: "From what I have seen of it, I think that it is the most pernicious scale insect known in this country; certainly I never saw another species so abundant as this one is in certain orchards which I have visited. It is said to infest all the deciduous fruits grown in California, excepting the peach, apricot and the black tartarian cherry. It attacks the bark of the trunk and limbs as well as the leaves and fruit. I have seen many plum and apple trees upon which all the fruit was so badly infested that it was unmarketable." Since Professor Comstock wrote the above, the insect has been found on apricot and peach as well as other plants.

In 1882 it had extended into all the fruit-growing districts of California, and has since that time been distributed over the country more or less widely, and is now known to occur in Oregon, Washington, British Columbia, Idaho, Nevada, Arizona, New Mexico, Missouri, Indiana, Florida, Virginia, Maryland, Pennsylvania, New Jersey, New York and Massachusetts. It does not appear to be very generally distributed as yet in the Eastern States, but there is great danger that it may soon become so through the distribution of infested nursery stock, if the most active measures are not adopted for its destruction.

The dissemination of this insect in the Eastern States has been traced by the entomologist of the Department of Agriculture in Washington to nursery stock received from Missouri and New Jersey. Prof. J. B. Smith, in "Entomological News," Vol. 6, page 153, and elsewhere, mentions two large nurseries in New Jersey that were badly infested with this scale, and from which infested stock had been sent to various points in the Eastern States. One of these was owned by Messrs. Parry, at Parry, Burlington County, N. J., the other by the J. T. Lovett Company, at Little Silver, Monmouth County, N. J.

Prof. L. O. Howard, entomologist to the Department of Agriculture in Washington, in studying the geographical distribution of this and other insects in connection with the life zones into which this country has been divided, has expressed the opinion that the San José scale is not likely to thrive on fruit trees in New England, for a time at least. Professor Smith seemed to entertain the same opinion, based on his studies of the distribution of the insect in New Jersey. I had therefore felt quite easy about the matter, so far as Massachusetts was concerned, till, on the 29th of March of the present year (1895), my attention was called to scale insects on several young plum trees on the grounds of the horticultural department of the Massachusetts Agricultural College. These trees, according to the record books, came from the J. T. Lovett Company, Little Silver, N. J., in the spring of 1894. Fearing that we had this dreaded insect to deal with, I sent infested twigs to Professor Howard for determination, and received the reply that they were the San José scale, but that none of the examples sent were alive.

Wishing to determine whether any of these insects had survived the winter, I had two of the trees taken up and set out in the cold part of the insectary greenhouse, and the remaining infested trees were burned. Scales appeared on the growth of the previous year, so that the insects succeeded well at least during the summer of 1894. On June 10 live scales were observed on the trees transplanted to the insectary greenhouse, and on the 14th the young were swarming all over them, and even extended to some small apple trees growing near in the same part of the greenhouse. As this seemed to settle the question of their ability to survive our winters here in Amherst, or at least the winter of 1894–95, which was an average one, I had all these trees very carefully burned, to prevent any further spreading of the pest.

As soon as it was discovered that the San José scale had been received here on nursery stock from outside of the State, I feared that other nurseries might have become infested in a similar manner, and therefore I sent my assistant, Mr. Lounsbury, to different nurseries to look for them. He reported that on April 19 he found the San José scale on two plum trees, two pear trees and a rose bush in Roslindale, Mass. The plum trees were badly infested with living scales, while the pear trees and rose bush were but slightly so. The scales occurred on all parts of the trees, but were the least numerous on the new growth. The pear trees had been on the grounds for three years and the plum trees two years. Mr. Lounsbury was informed that these trees were obtained from a local agent in West Roxbury, who claimed to have purchased them from the Shady Hill nursery, Bedford, Mass. On April 23 Mr. Lounsbury visited the Shady Hill nursery, and found the San José scale alive in large numbers on several different varieties of apple trees. Mr. Kohler, in charge of the nursery, told him that these trees were bought from the Cambridge nurseries, where they had been growing three or four years. The Cambridge nursery was then visited, and pear, peach and apple trees were found infested with the scale, and many of the worst-infested trees were dead. As no stock had been added to this nursery for three years, these trees must have been infested at least that length of time. I have not been able to learn from what source the stock in this Cambridge nursery was obtained.

On July 9 I received a twig of an apple tree from Mr. W. W. Rawson, with the request to inform him what the matter was with it. An examination showed that it was infested with the San José scale. Further correspondence revealed the fact that the twig came from an apple tree in the orchard of Mr. E. E. Cole, in the town of Scituate. Mr. Cole wrote me that the orchard contained ninety trees that were set out three years ago. It is situated in a protected spot with trees on three sides, and is within two miles of the ocean in a direct line. He also wrote me that the trees were received from Mr. Rawson, who informed me that he obtained most of his nursery stock of that description from the Shady Hill Nursery Company.

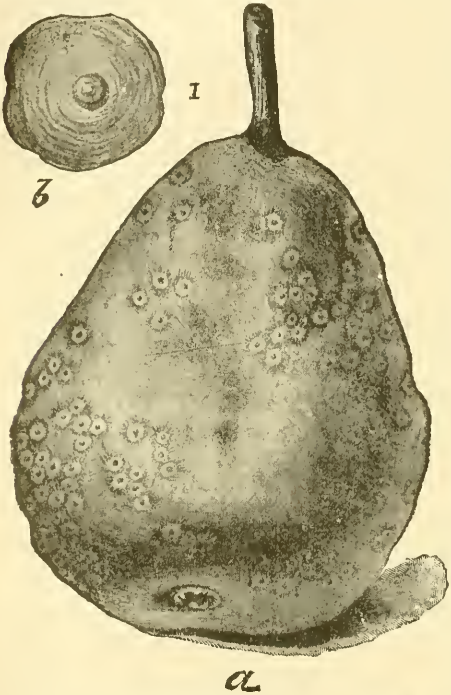

FIG. 1.—*a*. San José scales on a pear. *b*. A female scale enlarged.

It is therefore probable that the Shady Hill nurseries received infested stock from some outside nursery, possibly in New Jersey, and have unintentionally become a centre of infection for orchards in the eastern part of this State. To what extent this pest has become distributed through the State it is impossible to say, but that it is able to live and destroy fruit trees in some, if not in all, parts of the State seems evident from this history, which is given here quite at length because of the expressed opinion of Messrs. Howard and Smith that it would not survive in New England.

DESCRIPTION OF THE SCALE AND INSECT.*

The female scale is shown in Fig. 1, *a*, of the natural size, on a moderately infested pear, and at *b*, greatly enlarged. It is quite flat, nearly circular in outline, about one-sixteenth of an inch in diameter, and dark mottled with gray in color, with a small elevated spot at or near the centre, which is black or yellowish.

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* The cuts used to illustrate this paper are from the United States Department of Agriculture, through the kindness of Prof. L. O. Howard.

The male scale is "black, somewhat elongated when fully formed. The larval skin is covered with secretions; its position is marked by a single nipple-like prominence, which is between the centre and the anterior margin of the scale. The scale of the male is more abundant than that of the female. It is often oval in shape and smaller in size than the female."

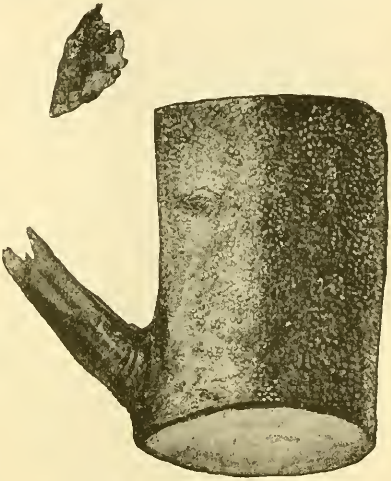

Fig. 2.—San José scales of natural size on an apple branch; scales somewhat enlarged on apple bark to the left above.

When these scales occur in large numbers on the twigs (Fig. 2) or leaves they frequently overlap, and are not easily distinguished without a magnifying glass. The general appearance which they give is of a greenish, very slightly roughened scurvy deposit. The natural color of the limbs of

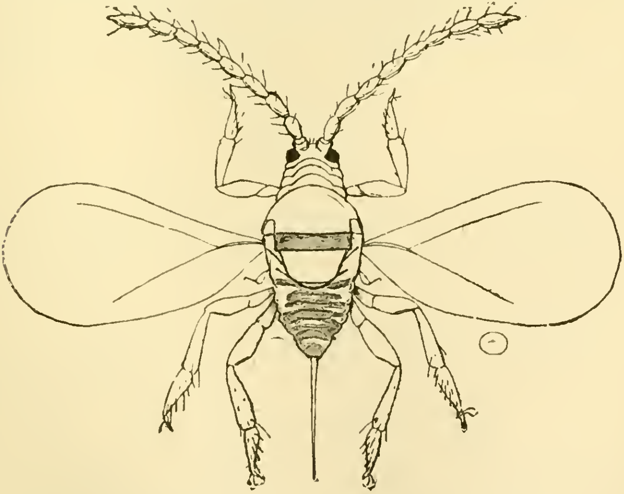

Fig. 3.—Male insect of the San José scale, greatly enlarged.

the peach and apple is quite obscured when these trees are thickly infested, and they then have the appearance of being coated with lime or ashes. When the scales are crushed a yellowish liquid appears, resulting from the crushing of the soft, yellow insect beneath, which indicates the existence of living scales on the trees.

These scales are often found on the fruit (Fig. 1), and when present in large numbers they prevent the full development of the fruit, causing it to crack or fall from the tree, or render it unsalable.

The mature male is very small, and supplied with two well-developed wings. It is shown greatly enlarged in Fig. 3, the natural size being indicated by the crossed lines in the small circle below the right wing.

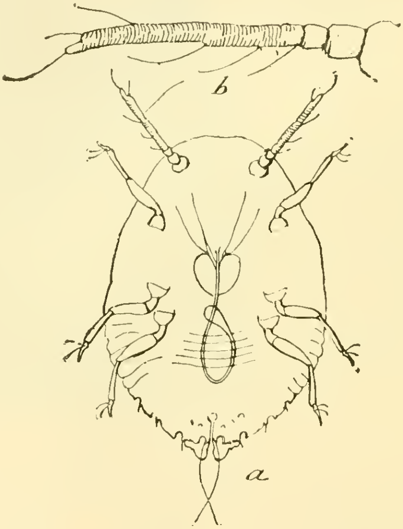

FIG. 4.—*a*. Young larva of San José scale insect, under side, greatly enlarged. *b*. Antenna still more enlarged.

Early in June, in this State, the young crawl out from beneath the scale and spread over the trees. They appear like moving points of a yellowish color, and it is very difficult to distinguish them with the unaided eye. Fig. 4 represents the insect at this stage of its existence very much enlarged, with its three pairs of legs and one pair of antennæ (one of which is still more enlarged at *b*), while its long, hair-like beak or proboscis, used for feeding, is shown curled up between its legs.

The mature female, represented greatly enlarged in Fig. 5, is only to be seen by removing her from beneath the scale at the proper stage of development. When the young as described above has reached a satisfactory place of abode in its wanderings, it forces its sharp beak or proboscis into the bark and draws in the sap of the tree, and begins to form its scale. It grows and soon moults its skin, at which time it loses its legs and antennæ, and takes the form represented in Fig. 5. Several broods of this insect occur in a season, the exact number of which is still in doubt, but possibly as many as five.

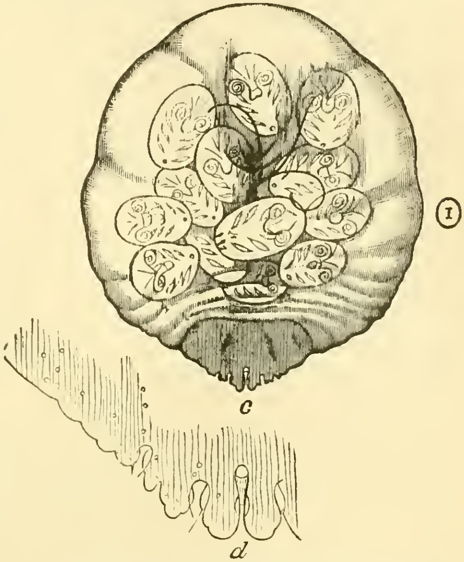

FIG. 5.—*c*. An enlarged view of an adult female of the San José scale insect, containing young. *d*. A portion of its anal fringe still more enlarged.

FOOD PLANTS.

The list of food plants of the San José scale insect, so far as known, are as follows: apple, pear, peach, plum, cherry, apricot, quince, flowering quince, almond, spiræa, raspberry, rose, hawthorn, cotoneaster, gooseberry, currant, flowering currant, persimmon, elm, osage orange, linden, euonymus, acacia, English walnut, pecan nut, alder, weeping willow and laurel-leaf willow.

METHODS OF DISTRIBUTION.

As the mature female is wingless, and fixed to the tree on which she feeds, she will not be likely to cause other regions to become infested unless the tree to which she is attached is removed. Her progeny, however, when they are moving about freely, may be transported to places more or less distant by other insects, birds, larger animals or even by man; but the chances are not favorable for any very wide dispersion in this way. They may, however, be carried from one tree to another at no great distance. Infested fruit may be transported from one part of the country to another, and by chance be left in some place where it is possible for the young to crawl to some suitable food plant; but by far the most favorable method for the wide distribution of this insect is on nursery stock, and to this the most careful attention should be given.

It will be decidedly to the advantage of every dealer in nursery stock to take measures to clean his trees from this scale and to keep them free, for, if this be not attended to, purchasers will find other and more satisfactory parties to deal with.

REMEDIES.

If only a comparatively few small trees are infested in a nursery or orchard, the best way is to burn them, taking great care that in doing so none are scattered. There is no method of destroying insects equal to cremation.

Professor Howard, after having a long series of experiments performed for the purpose of ascertaining the best and most economical method of destroying this insect, says: "The only perfect results that have been reached have come from the application of two pounds or more of commercial fish-oil or whale-oil soap to a gallon of water soon after the leaves fall in the autumn, and from the application of a resin wash of six times the normal summer strength. The effects following the application of these washes leave nothing to be desired. In all cases the most careful search over the sprayed trees has failed to show a living scale." These are known as "winter washes," since they can only be used during the winter without serious injury to the trees. The winter resin wash mentioned above is composed of resin, one hundred and twenty pounds; caustic soda, thirty pounds; fish oil, fifteen pints; water sufficient to make one hundred gallons. The resin and soda are broken up and placed in a large kettle with the oil and sufficient water to cover them; the whole is then boiled for several hours, or until the compound will properly mix in water without breaking up into yellowish flakes. Experiments thus far made with applications during the summer have failed to give a substance that will destroy all of the insects. As good results have been obtained from the use of ordinary kerosene emulsion as from any other substance. It was found advisable, however, to repeat the spraying at intervals of about a week, as the young are brought forth in succession during the season. Kerosene emulsion is composed of kerosene oil, two gallons; common soap, one-half pound; water, one gallon. Cut up the soap and boil it in the water till it is all dissolved, then add it, boiling hot, to the oil, and churn it briskly for five minutes or more with a spraying or force pump. When required for use mix thoroughly one part of the above emulsion with nine parts of water and spray the trees with it. In spraying peach trees, however, it is recommended, because of their liability to injury, to mix one part of the emulsion with fifteen parts of water. The emulsion will dissolve more readily if hot water be used.

Legislation.

It is strongly recommended by some entomologists to have laws passed requiring nurserymen and other dealers to guarantee their stock free from the San José scale; but I am free to confess that I feel very doubtful about this matter. It seems to me that the fear of loss of trade will be a greater incentive to send out only uninfested stock than the fear of any amount of legislation.

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Lancaster,	Lancaster,	George W. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
Lunenburg,	Lunenburg,	C. E. Cox, Lunenburg.	James Hildreth, 2d, Lunenburg.

New Braintree,	New Braintree,	D C Wetherell, New Braintree.	Horatio Moore, New Braintree.
New Salem,	New Salem,	D. F. Carpenter, Millington.	Willard Putnam, Cooleyville.
North Westport,	North Westport,	E. L Gifford, North Westport.	A. S. Sherman, North Westport.
Practical,	Egremont,	H. Z. Cande, Sheffield	Mrs. C. B. Benedict, South Egremont.
Rehoboth,	Rehoboth,	F. A. Bliss, Pawtucket, R. I.	A. A. Bliss, Pawtucket, R. I.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
Royalston,	Royalston,	A. D. Raymond, Royalston.	G. E. Pierce, Royalston.
Rutland,	Rutland,	Daniel Demond, Rutland.	Mrs. J. W. Munroe, Rutland.
Southborough.	Southborough,	Wm. H. Buck, Southborough.	D. W. C. McMasters, Southborough.
South Bristol,	New Bedford,	Franklyn Howland, Acushnet.	A P. R. Gilmore, Long Plain.
Sterling,	Sterling,	L. B Kendall, Sterling.	Ezra Sawyer, Sterling.
Tatnuck,	Worcester,	Elliott Moore, Worcester.	W. W. Clapp, Tatnuck.
Upton,	Upton,	Chas. A. Whitney, Upton.	P. W. Rockwood, Upton.
Waltham,	Waltham,	M. R. Leonard, Waltham.	A. Starbuck, Waltham.
West Bridgewater,	West Bridgewater,	F. E. Howard, West Bridgewater.	Anna S. LeLacheur, W. Bridgewater.
West Brookfield,	West Brookfield,	W. E. Patrick, Warren.	L. H. Chamberlain, West Brookfield.
West Newbury,	West Newbury,	E. G. Nason, West Newbury.	A. L. Moore, Newburyport.
West Peabody,	West Peabody,	Mrs. F. C. Durkee, West Peabody.	Bertha G. Small, West Peabody.
Wilbraham,	Wilbraham,	G. B. F. Green, North Wilbraham.	H. M. Bliss, Wilbraham.

MISCELLANEOUS.

Agricultural Library Association,	Swansea,	James E. Easterbrooks, Swansea Centre	A. E. Arnold, Swansea Centre.
Boston Market Gardeners' Association,	Boston and vicinity,	W. W. Rawson, Arlington.	C A. Learned, Arlington.
Bristol Co Fruit Growers' Association,	Dighton,	N. W. Shaw, North Raynham.	Wm. P. Eddy, Dighton.
Bay State Agricultural Society,*	Boston,	J. D W. French, Boston.	C M. Weld, Brookline.
Brockton Agricultural Society,*	Brockton,	H. W. Robinson, Brockton.	Ira Copeland, Brockton.
Burlington Agricultural Society,	Burlington,	– – –	H. H. Nichols, Burlington.
Cranberry Growers' Association,	Cape Cod District,	A. D. Makepeace, West Barnstable.	Franklin Crooks, Hyannis.
Farmers' and Gardeners' Club,	Hanson,	George F. Simpson, Hanson.	F. S. Thomas, M.D., Hanson.
Franklin Harvest Club,	Connecticut Valley,	J B. Packard, Conway.	C. B Lyman, Southampton.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	J. N. Bagg, West Springfield.
Massachusetts Fruit Growers' Association,	The State,	James Draper, Worcester.	Prof. S. T. Maynard, Amherst.
Westborough Agricultural Society,*	Westborough,	Wm. N Barrett, Westborough.	F. P. Rogers, Westborough.
Young Men's Harvest Club,	Ludlow,	H E. Miller, Ludlow.	E. N. Fisher, Ludlow.
Young People's Agricultural Club,	Wilbraham,	Lee W. Rice, Wilbraham.	Walter M. Bliss, Wilbraham.

* Incorporated under general laws.

MASSACHUSETTS PATRONS OF HUSBANDRY.

Officers of the State Grange, 1896.

Master,	E. D. Howe of Marlborough.
Overseer,	E. A. Emerson of Haverhill.
Lecturer,	J. W. Stockwell of Sutton.
Steward,	Walter B. Mellen of Brookfield.
Assistant Steward,	Wm. N. Howard of South Easton.
Chaplain,	Rev. C. S. Walker of Amherst.
Treasurer,	F. A. Harrington of Worcester.
Secretary,	W. C. Jewett of Worcester.
Gate Keeper,	Chas. M. Wood of Upton.
Pomona,	Mrs. Elbridge Cushman of Lakeville.
Flora,	Mrs. Lizzie H. Sargent of Merrimac.
Ceres,	Mrs. Emma Eaton of Fitchburg.
Lady Assistant Steward,	Mrs. S. Ella Southland of Athol.

Executive Committee.

H. A. Barton,	Dalton.
C. A. Dennen,	Pepperell.
Geo. L. Clemence,	Southbridge.

Deputies.

Geo. S. Ladd,	Sturbridge.
J. F. Whitcomb,	Athol.
Marcellus Boynton,	Central Village.
Wm. N. Howard,	South Easton.
T. E. Flarity,	Townsend.
Herbert Sabin,	Amherst.
F. H. Stevens,	West Acton.
C. D. Richardson,	West Brookfield.
Chas. G. Hinckley,	Lee.
F. G. Bennett,	Ludlow.
Alonzo Eaton,	Fitchburg.
W. C. Jewett,	Worcester.
Edward A. Fuller,	North Andover.

Special Deputy.

W. B. Barton,	Dalton.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	H. N. Rogers, Holliston.	Abel F. Stevens, Wellesley.	Mrs. N. H. Fales, Pondville.
Essex County, No. 2,	B. F. Huntington, Amesbury.	George E. Crosby, Tewksbury.	Matilda B. Lund, West Boxford.
Middlesex and Worcester, No. 3,	O. E. Patch, Concord	Mrs. Ella Mayo, Ashby.	Mrs. Annie E. Robbins, Lowell.
Franklin and Worcester, No. 4,	L. H. Woodbury, Royalston.	C. A. Stimson, Royalston.	Mrs. A. A. Hill, Athol.
Worcester West, No. 5,	W. H Sawyer, Winchendon.	Lyman Randall, North Dana.	T. B. Clark, Baldwinville.
Berkshire County, No. 6,	W. B Barton, Dalton.	Chas. Shaylor, Lee.	M. Agnes Young, Dalton.
Worcester Central, No. 7,	George S. Eddy, Oxford.	Mrs. A. F. Brown, East Douglas.	Geo. H. Rice, Worcester.
Hampshire County, No. 8,	Herbert Sabin, Amherst.	Howard C. West, Belchertown.	Miss Sarah E. Mason, Northampton.
Worcester Southwest, No. 9,	Harris M. Dodge, Charlton.	Mrs. Mary Olds Lakin, Brookfield.	Charles M. Perrin, Dudley.
Worcester and Norfolk, No. 10,	Albert W. Gaskill, Mendon.	Abbie M. Lapham, Mendon.	John E. Hollis, Uxbridge.
Borough, No. 11,	Joseph Walker, Marlborough.	Mrs. Mary C. Graham, Westborough.	Mrs. M. S. Wood, Northborough.
Springfield, No. 12,	C. C. Keep, Monson.	Mrs. Chas. H. Burleigh, Hampden.	Mrs. C. Leonard Hayward, Agawam.
Old Colony, No. 13,	I. H. Lamb, Stoughton.	Joseph Gibbs, Somerset.	Mrs. Geo. W. Stevens, South Braintree.
Worcester East, No. 14,	A H. Melendy, Sterling.	Mrs. M. H. Mentzer, Bolton.	Mrs. E. T. Cunningham, Lancaster.
Subordinate Granges.			
Northfield, No. 3,	H. H. Mason, Northfield.	Miss Jennie Pierce, Northfield.	W. M. Moore, Northfield.
Groton, No. 7,	Myron P. Swallow, Groton.	George S. Knapp, Groton.	Eva A. Clark, Groton.
Barre, No. 9,	P. M. Harwood, Barre.	Mrs. H. N. Patterson, Barre.	E. W. Nourse, Barre.
Amherst, No. 16,	C. L. Nims, Amherst	Miss Jennie M. Allen, Amherst.	Alice F. Dickinson, Amherst.
Hinsdale, No. 19,	C. C. Robinson, Jr., Hinsdale.	Mrs. F. F. Watkins, Hinsdale.	John S. Cole, Hinsdale.
Lanesborough, No. 21,	S. L Miner, Lanesborough.	W. S. Royce, Lanesborough.	Chas. H. Deming, Lanesborough.
Worcester, No. 22,	F. H. Chamberlain, Worcester.	John B. Bowker, Worcester.	Ellen M. Flagg, Worcester.
Dalton, No. 23,	W. B. Warren, Dalton.	Mrs. W. H. Woodworth, Dalton.	M. Agnes Young, Dalton.
Middlefield, No. 33,	M. J. Smith, Middlefield.	Helen M. Wright, Middlefield.	Anna Alderman, Middlefield.
Sterling, No. 53,	John P. Brittle, Clinton.	Lonis Stuart, Sterling.	Jos. R. Graham, Clinton.
Auburn, No. 60,	J. H. Prouty, Auburn.	H. J. Marcy, Auburn.	Mrs. Geo. M. Allen, Auburn.
"Union" of Belchertown, No 64,	W. H. Bridgman, Belchertown.	M. A. Morse, Belchertown.	Mrs. M. G. Ward, Belchertown.
Hardwick, No. 67,	Geo. S. Prouty, Furnace.	Mrs. W. A. Newcomb, Hardwick.	W. A. Newcomb, Hardwick.
Phillipston, No. 70,	G. R. Johnson, Templeton.	M. B. Hager, Templeton.	W. L. Wheeler, Templeton.
"Prescott" of Pepperell, No. 73,	W. S. Parker, Pepperell.	J. L. Boynton, Pepperell.	E. S. Blood, Pepperell.
Holden, No. 78,	Fred L. Chamberlain, Greendale.	Mrs. B. M. Chamberlain, Holden.	Mrs. S. N. Hubbard, Holden.

Massachusetts Patrons of Husbandry — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Spencer, No. 79,	A. W. Hoyle, Spencer.	P. Emerson, Spencer.	C. W. Grosvenor, Leicester.
"Manhan" of Southampton, No. 82,	J. S. Frary, Southampton.	Mrs. C. P. Gridley, Southampton.	Mrs. Geo. K. Edwards, Southampton.
North Orange, No. 86,	A. C. White, North Orange.	M. D. Herrick, North Orange.	Mrs. Effie R. Wakefield, Tully.
Lee, No. 88,	Anson Buck, Stockbridge.	Mrs. Cora Dikeman, Lee.	Mrs. C. O. Swift, Lee.
Charlton, No. 92,	Chauncy Pike, Charlton City.	Guy C. Prindle, Southbridge.	Archie R. Bigelow, Charlton.
Grafton, No. 93,	Henry R. Leland, Grafton.	Fred E. Goddard, Farnumsville.	Mrs. Minnie J. Pharaoh, Grafton.
Petersham, No. 95,	H. H. Lindsey, Petersham.	R. J. Stone, Petersham.	Mary E. Prouty, Petersham.
Shrewsbury, No. 101,	Wm. E. Rice, Shrewsbury.	Emily A. Carey, Shrewsbury.	Anne S. Rice, Shrewsbury.
Stow, No. 103,	C. W. Crandall, Stow.	Mrs. Geo. Bolam, Rockbottom.	Mrs. U. M. Lewis, Stow.
"Garfield" of North Dana, No. 104,	George A. Kendall, North Dana.	Moses T. Knapp, North Dana.	Allen W. Goodman, North Dana.
Marlborough, No. 105.	Fred. L. Putnam, Marlborough.	C. S. Howe, Marlborough	Abbie A. Nichols, Marlborough.
West Boylston, No. 106,	Wm. C. Peirce, West Boylston.	Helen E. Peirce, West Boylston.	Mrs. A. D. Lord, West Boylston.
Millbury, No. 107,	Herbert McCracken, West Millbury.	Henry W. Carter, West Millbury.	Mrs. J. C. Hayward, Millbury.
Hudson, No. 108,	Fred W. Ordway, Hudson.	Susie J. Hale, Hudson.	Mary E. Hall, Hudson.
Sutton, No. 109,	Frank Slayton, Sutton.	John E. Gifford, Sutton.	Sarah M. Mills, Sutton.
Sherborn, No. 110,	G. L. Whitney, South Framingham.	Geo. F. Gale, East Holliston.	Miss A. L. Bickford, Sherborn.
Boylston, No. 111,	Geo. H. Hastings, Boylston Centre.	Nathaniel Kendall, Boylston Centre.	. H. Warner, Boylston Centre.
"East Medway" of Millis, No. 112,	Henry E. Hosmer, Millis.	Augustus L. Ware, Millis.	Osgood T. Dean, Millis.
Framingham, No. 113,	Joseph W. Holbrook, Framingham.	George E. Fay, Framingham.	John A. Furber, Framingham.
Medfield, No. 114,	Mrs. S. Minnie Chase, Medfield.	Mrs. E. C. Stone, Medfield.	Mrs. W. W. Preston, Medfield.
Holliston, No. 115,	S. G. Herrick, Holliston.	Mrs. Elmira Marshall, Metcalf.	Frances J. Hayes, Holliston.
Westborough, No. 116,	Elijah B. Emery, Westborough.	Mrs. J. A. Gilmore, Westborough.	Ella C. B. Leonard, Westborough.
Dover, No. 117,	John A. McGill, South Natick.	Mrs. S. A. Higgins, Dover.	Fannie C. Paine, Dover.
Southborough, No. 118,	Paul S. Lincoln, Southville.	Albert E. Hutt, Southborough.	Nellie A. Canty, Southborough.
Northborough, No. 119,	J. K. Mills, Northborough.	M. S. Wood, Northborough.	Edith J. Bemis, Northborough.
Lancaster, No. 120,	E. T. Cunningham, Lancaster.	Mrs. E. T. Cunningham, Lancaster.	Miss E. C. Divoll, Lancaster.
Sudbury, No. 121,	L. W. Gilbert, South Sudbury.	Francis F. Walker, South Sudbury.	Fred A. Noyes, Sudbury.
Templeton, No. 122,	E. C. Hersey, Templeton.	E. B. Burnheimer, Templeton.	Thomas B. Clark, Baldwinville.
Oxford, No. 123,	Franklin H. Clark, Oxford.	Mrs. D. M. Howe, Oxford.	Walter A. Lovett, Oxford.
Ashland, No. 124,	James Adams, Ashland.	Chas. Adams, Ashland.	Fannie A. Pratt, Ashland.

Upton, No. 125,	Albert Davis, Upton.	Myrtice S. King, Upton.	L. Jennie Chapman, West Upton.
Hubbardston, No. 126,	John G. Allen, Hubbardston.	Mabel F. Gleason, Hubbardston.	J. Harry Allen, Hubbardston.
Amesbury, No. 127,	Gideon W. Evans, Amesbury.	Eben True, Amesbury.	Nellie A. Huntington, Amesbury.
North Andover, No. 128,	S. D. Berry, North Andover.	M. B. Meserve, North Andover.	Lizzie F. Ingalls, North Andover.
Gardner, No. 130,	J. W. Osborne, West Gardner.	W. E. Knight, Gardner.	A. F. Johnson, West Gardner.
Boxborough, No. 131,	N. E. Whitcomb, West Acton	C. A. Perkins, West Acton.	Mrs. A. Littlefield, West Acton.
North Brookfield, No. 132,	C. D. Richardson, West Brookfield.	L E. Barnes, North Brookfield.	Geo. P. Buck, North Brookfield.
West Dedham, No. 133,	W. W. Baker, West Dedham.	Addie L. Gay, West Dedham.	Irene Roby, West Dedham.
Berlin, No. 134,	S. C. Chamberlain, Berlin.	Henry A. Wheeler, Berlin.	Mrs. Chas. H. Allen, South Berlin.
Norfolk, No. 135,	John E. Fales, Norfolk.	S. T. Rockwood, Norfolk.	Mrs Sarah B. Sims, Norfolk.
Ipswich, No. 136,	O. C. Smith, Ipswich.	F. A. Stackpole, Ipswich.	C. F. Damon, Ipswich.
East Blackstone, No. 137,	Sylvanus H. White, Blackstone.	Nannie I. White, Blackstone.	Mabel G. Scott, Woonsocket, R. I.
Northampton, No. 138,	Clayton S. Parsons, Northampton.	Mrs. James W. Wilson, Northampton.	Miss Sarah E. Mason, Northampton.
East Sandwich, No. 139,	John F. Carleton, East Sandwich.	R. F. Armstrong, East Sandwich.	Geo. Parker, East Sandwich.
West Boxford, No. 140,	William K. Cole, West Boxford.	George B. Austin, West Boxford.	Matilda B Lund, West Boxford.
Montague, No. 141,	Geo. H. Goddard, Montague.	Chas. M. Hemenway, North Leverett.	F. A. Rist, Montague.
Bolton, No. 142,	Everett M. Walcott, Bolton.	Clara S. Walcott, Bolton.	Dorcas H. Babcock, Bolton.
Mendon, No. 143,	Moses U. Gaskill, Mendon.	J Grace Lowell, Mendon.	Albert W. Gaskill, Mendon.
Franklin, No. 144,	Henry R. Jenks, Franklin.	Mrs. J. L Fisher, City Mills.	Alice A. Duprez, Franklin.
Douglas, No. 145,	J. A. Williams, East Douglas.	Mary Richardson, Douglas.	E. T. Rawson, East Douglas.
West Newbury, No. 146,	Robert L. Smith, West Newbury.	Mrs. Lizzie M. Newell, West Newbury.	Ethel B. Carleton, West Newbury.
West Springfield, No. 147,	H. L. Phelps, West Springfield.	F. H. Plumb, Springfield.	E. T. Sikes, West Springfield.
Swansea, No. 148,	Wm. D. Coggeshall, Warren, R. I.	Alice Cleaveland, Swansea Village	Susie C. Phillips, Swansea Centre.
Harvard, No. 149,	H. L. Knight, Harvard.	Mrs. Fannie Shores, Harvard.	Isaac P. Baker, Harvard.
Concord, No. 150,	O. E. Patch, Concord.	Mary H. Williams, Concord.	Chas. E. Derby, Concord.
Agawam, No. 151,	A. H. Brown, Agawam.	Mrs. E. L. Thompson, Agawam	E. L. Covill, Agawam.
East Longmeadow, No. 152,	E. Cope, East Longmeadow.	Rev. W. H. Adams, East Longmeadow.	Mrs. C. L. Cooley, East Longmeadow.
Wilbraham, No 153,	Edgar C. Clark, Wilbraham.	Mrs. Edgar C. Clark, Wilbraham.	Mrs. W. L. Phelps, Wilbraham.
Haverhill, No. 154,	Chas. F. Marshall, Ayers Village.	Susan A. Eastman, Haverhill.	Elmina C. Gordon, Ayers Village.
Methuen, No. 155,	T. C. Foster, Methuen.	Bessie Swan, Lawrence.	M A. Crosby, Methuen.
West Bridgewater, No. 156,	E. Bradford Wilbur, West Bridgewater.	Chas. G. Manley, Brockton.	Chas. R. Packard, West Bridgewater.
Granby, No. 157,	A. J. Whitmarsh, Granby.	Mrs. M. M. Whitmarsh, Granby.	W. S. Clark, Granby.
"Nemasket" of Middleborough, No. 158,	John G. Pann, Middleborough.	- - -	Annie D. Deane, Middleborough.
"Green River" of Williamstown, No. 159,	S. A. Hickox, South Williamstown.	Arthur Galusha, Williamstown.	A. Jeannette Kellogg, Williamstown.
South Hadley, No. 160,	C. A. Judd, South Hadley Falls.	Mrs. E. S. Johnson, Hadley.	L. B. Allen, South Hadley.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
"Laurel" of West Newbury, No. 161,	Robert J. Forsyth, West Newbury.	Mary L. Rogers, West Newbury.	Sam Rogers, West Newbury.
Dartmouth, No. 162,	Henry M. Plummer, South Dartmouth.	Thos. J. Barry, Dartmouth.	J. H. Slocum, Dartmouth.
Dudley, No. 163,	D. S. Elliott, Dudley.	Clara M. Arnold, Dudley.	Hattie M. Marsh, Webster.
Ware, No. 164,	L. B. Sanford, Ware.	E. W. Barney, Ware.	Mrs. E. W. Barney, Ware.
Hampden, No. 165,	Dr. Geo. T. Ballard, Hampden.	Mrs. C. H. Burleigh, Hampden.	Mrs. A. J. Tuttle, Hampden.
Wellesley, No. 166,	Wm. Lyon, Wellesley Hills.	Geo. L. Chesbro, Wellesley Hills.	Geo. N. Smith, Newton Lower Falls.
Somerset, No. 168,	G. W. Rice, Pottersville.	J Gibbs, Pottersville.	Edith E. Crowell, Pottersville.
Lunenburg, No. 169,	E. S. Marshall, Lunenburg.	May V. Estabrook, Lunenburg.	James Hildreth, Lunenburg.
New Braintree, No. 170,	H. L. Pollard, New Braintree.	E. L. Havens, New Braintree.	Mrs. Emma A. Moore, New Braintree.
Merrimac, No. 171,	Chas. Emery Hoyt, Merrimac.	Mrs. F. E. Bartlett, Merrimac.	T. L. Goodwin, Merrimac.
Ashby, No. 172,	A. Wetherbee, Ashby.	J. A. Piper, Ashby.	M. W. Jefts, Ashby.
Hopkinton, No. 173,	W. V. Thompson, Woodville.	Emma Thompson, Woodville.	Rosa Pond, Hopkinton.
Brookfield, No. 174,	N. C. Harwood, Brookfield	Mrs. Nancie S. Allen, Brookfield.	Cora B. Mitchell, Brookfield.
Athol, No. 175,	Calvin A. Drury, Athol Centre.	Inez L. Wood, Athol Centre.	Matilda J. Tooley, Athol Centre.
"Miller's River" of Orange, No. 176,	Lyman H. Jerome, Orange.	M. A. Jerome, Orange.	Ernest C. Stimpson, Orange.
Sturbridge, No. 177,	J. D. Underwood, Fiskdale.	Jennie S. Gilbert, Sturbridge.	C. L. Edgerly, Sturbridge.
Monson, No. 178,	O. Pease, Monson.	Myron Blanchard, Monson.	F. D. Rogers, Monson.
Ludlow, No. 179,	F. E. Sikes, North Wilbraham.	F. O. Taylor, Ludlow.	Maybelle Whitney, North Wilbraham.
West Brookfield, No. 180,	Mary F. Holmes, West Brookfield.	Chas. E. Smith, West Brookfield.	Sadie A. Webb, West Brookfield.
Westport, No 181,	Marcellus Boynton, Central Village.	Annie R. Howland, Central Village.	Agnes H. Allen, South Westport.
Southbridge, No. 182,	Willard P. Morse, Southbridge.	Dr. Wm. G. Reed, Southbridge.	Mrs. Sarah E. Torrey, Southbridge.
Andover, No. 183,	Chas. L. Bailey, Andover.	Edw. W. Burtt, Andover.	Mrs. Carrie A. P. Gould, Andover.
Topsfield, No. 184,	C. F. Jordan, Topsfield.	B. J. Balch, Topsfield.	Mrs. Lillie Donaldson, Topsfield.
Fitchburg, No. 186,	D. P. Bartlett, Fitchburg.	Lewis M. Lowe, Fitchburg.	Jennie M. Hills, Fitchburg.
"Satuit" of Scituate, No. 187,	Geo. W. Griggs, Norwell.	F. J. Croning, Norwell.	Chas. O. Ellms, Greenbush.
Littleton, No. 188,	W. H. Davis, Littleton.	Mrs. Minnie W. Fletcher, Littleton Common.	Augusta W. Smith, Littleton Common.
Warren, No. 189,	C. M. Sylvester, Warren.	A. N. Tuttle, Warren.	A. A. Warriner, Warren.
Bellingham. No. 190,	Daniel J. Sullivan, Bellingham.	John H. Dodge, Bellingham.	John J. O'Sullivan, Bellingham.
Chestnut Hill, Blackstone, No. 191,	Wm. A. Dodge, Millville.	Minnie Irons, Millville.	Mrs. Eleanor R. Tiffany, Millville.

Winchendon, No. 192, . .	Edson B. Bemis, Winchendon.	William E. Holden, Winchendon.	Ardella E. Gregory, Winchendon.
Foxborough, No. 193, . .	James W. Alden, Foxborough.	Geo. W. Scott, Foxborough.	Aurelia L. Buck, Foxborough.
Townsend, No. 194, . . .	T. E. Flarity, Townsend.	E. F. Gates, Townsend.	G. A Wilder, Townsend.
Royalston, No. 195, . . .	C. A. Stimson, Royalston.	Miss Gertrude Turner, Royalston.	Mrs. Cora E. Forbes, Royalston.
Easton, No. 196, ...	Edward B. Maglathlin, North Easton	Mrs. Maria L. Howland, South Easton.	Mrs. Willis B. Drew, North Easton.
"Brookville" of Holbrook, No. 197, ...	E. E. Bowen, Brookville.	Mrs. J. W. Strachan, Brockton.	Miss Mabel E. Bard, Brookville.
Leominster, No. 198, . . .	J. Nathan Page, North Leominster.	S. R. Walker, North Leominster.	F. K. Page, Leominster.
Stoughton, No. 199, . . .	Israel Lamb, Stoughton.	H. F. Maxwell, East Sharon.	Roby Gilbert, Stoughton.
Uxbridge, No. 200, . . .	John E. Hollis, Uxbridge.	Mrs. J. E. Hollis, Uxbridge.	Helen Sanderson, Uxbridge.
Bridgewater, No. 201, . . .	Gould E. Newcomb, Scotland.	Lizzie M. Thomas, Bridgewater.	Lucius C. Wood, Bridgewater.
Ashburnham, No. 202, . .	Chas. W. Whitney, Ashburnham.	Henry W. Holman, Ashburnham.	Sadie R. Whitney, Ashburnham.
Westminster, No 203, . .	A. E. Hurd, Westminster Depot.	Mabel F. Sawin, South Westminster.	Kate S. Knowlton, Westminster.
Rowley, No. 204, . . .	G. Fred Carleton, Millwood.	W. A. Foss, Rowley.	Sophy D. Carleton, Millwood.
"Webster" of Marshfield, No. 205, ...	Israel H. Hatch, North Marshfield.	Georgie M. Damon, North Marshfield.	Celia J. Wilson, North Marshfield.
Hanover, No. 206, . . .	Lot Phillips, West Hanover.	Albert J. Curtis, Hanover.	Hattie I. West, North Pembroke.
Tewksbury, No. 207, . . .	Geo. E. Crosby, Tewksbury.	Albert C. Blaisdell, Tewksbury.	Mrs. D. K. Vaughan, Tewksbury.
Westford, No. 208, . . .	J. W. Fletcher, Westford.	L. W. Wheeler, Westford.	J. Florence Wilson, Westford.
Hanson, No. 209, ...	Walter O. Monroe, South Hanson.	Mr. W. J. Holmes, North Hanson.	S. F. Turner, Hanson.
Shawmut (New Bedford), No. 210, ...	James E. Tripp, Shawmut.	Carleton E. Davis, Shawmut.	Wm. B. Collins, Shawmut

APPENDIX.

REPORT OF THE DELEGATES TO THE FARMERS' NATIONAL CONGRESS,*

AT ATLANTA, GEORGIA, 1895.

To His Excellency FREDERIC T. GREENHALGE.

SIR: — We acknowledge with pleasure the courtesy of your appointment as delegates for the State of Massachusetts to the Farmers' National Congress, which held its fifteenth annual session at Atlanta, Ga., on the 10th, 11th, 12th, 14th, 15th and 16th of October, in the year 1895, and we report as follows.

The Farmers' National Congress was organized at St. Louis, in 1877. There were but few persons present at the first meeting, but they were earnest and zealous in perfecting the organization, and were determined that it should become a power for good to the farming interests of the country. Since then the body has grown and flourished, until at the present time it numbers nearly a thousand regular and honorary members, covering every State in the Union, and representing every manner of farming and variety of farm products.

The Congress is composed of the same number of regular delegates as the Congress of the United States, the basis of representation being the same; the governor of each State appoints and commissions the same number of delegates as his State has representatives in the national Congress. In addition thereto, every agricultural college in the States is entitled to one representative. The Congress is non-partisan, and holds itself aloof from partisan politics.

In its later meetings are found men distinguished as the representatives of agriculture, — men who till the soil, invent agricultural implements, frame State and national laws for the government of the people, and men who otherwise advance the noble work of the farmer, and bring it to a place in the minds of the people at large it never before occupied.

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* This report has been transmitted to the secretary of the State Board of Agriculture by His Excellency the Governor, with the request that it be included in the "Agriculture of Massachusetts."

The attendance at the Congress in Atlanta was large, and brought together bright, intelligent and leading agriculturists from various States of the Union, to consider, discuss and act upon questions of national importance; and it is not too much to say of them that they discussed and acted upon the questions brought before them with an ability, decorum, judgment and order not surpassed in the State or national legislatures.

New England was represented by four delegates from Massachusetts and one from Rhode Island; Maine, New Hampshire, Vermont and Connecticut were unrepresented.

The fifteenth annual session of the Congress convened at the Auditorium on the Exposition Grounds, Oct. 10, 1895, at 11 o'clock A.M., with some two hundred members in attendance.

The president, Hon. B. F. Clayton of Iowa, called the Congress to order and presided over its meetings during the entire term. The other officers present were: G. M. Ryals of Savannah, vice-president; John M. Stahl of Chicago, secretary; W. H. Whidby of Atlanta, first assistant secretary; and T. J. Appleyard of Florida, second assistant secretary.

Prayer was offered by Rev. Mr. Bryan of Georgia, who earnestly besought divine guidance and blessings for the Congress. Hon. Porter King, mayor of Atlanta, was introduced, and made an address of welcome in behalf of the city of Atlanta. In his address he referred to the farmers as having a noble calling, and that agriculture was the basis of human life. He spoke of the many men born and reared upon farms, who had distinguished themselves in other walks of life. His address was timely, and in well-chosen words he extended to the members of the Congress a warm and cordial welcome.

Secretary John M. Stahl responded to the mayor's greeting, on behalf of the Congress. He said that he was stirred by the warm welcome accorded to the farmers, and felt satisfied that their coming to Atlanta would be profitable and pleasing to all the members.

Governor Atkinson, on account of official business, was unable to be present to welcome the Congress to Georgia in person, but in that duty he was ably represented by Dr. H. C. White, who did the honors on behalf of the State of Georgia. He paid a tribute of praise to the farmers for what they had achieved in agriculture; he was glad they came to Atlanta, and with warm expressions of welcome he hoped that the members of the Congress would enjoy their stay in Georgia's capital.

On behalf of the Georgia Agricultural Society, Rev. J. B. Hunnicutt spoke words of warm and cordial greeting to the members of the Congress.

In response, President Clayton made some pleasant and happy remarks, expressive of how pleasing thus far the reception to Atlanta had been, and, if such should continue, he thought the Congress would feel prouder for their coming, and greater in their love for Atlanta, the exposition, and the people of the city and the State.

President Clayton then delivered his annual address. He gave a warm greeting to the members; then called attention to the magnitude of agricultural pursuits, their pre-eminent importance to the comforts and the existence of the human family, and the relations they sustain to all professions and occupations.

"Since the creation of man," said he, "when he was placed in the garden of Eden, to dress and keep it, the farmer, the tiller of the soil, has ever stood between the world and want. The art of cultivating the ground and of obtaining from it the products necessary to sustain animal life was the first science in the development of the race valleys watered by the Euphrates, the Tigris and the Nile.

He then reviewed the history of agriculture from the ancient days of Egypt to the present time, showing its great strides in the present century.

"Like the ancient settlers of the valley of the Nile, the immigrant from all civilizations came to cultivate the rich valleys of this great new continent of ours. And, while they better understand the art of cultivating the soil, the mode seems primitive in comparison with the high art with which we are now blessed. Our forefathers in the beginning were farmers, carpenters, masons, merchants and manufacturers, complete though primitive in the individual. First and foremost he was a farmer, and he used the other avocations merely as incidental to the first and chief employment. Less than a half-century has elapsed since the spinning wheel and the hand loom were common and necessary in the American home. Fifty years ago the American farmer lived almost entirely within his own resources and within himself. He built his own cabin, constructed his own fireplace and chimney and fashioned his own farm implements.

"A portion of the field was set aside for flax, and when it was pulled, bleached and broken, it was manufactured into fabrics to supply the needs of the family. The cotton grown on the farm and the clippings from the flocks were submitted to various processes of preparation necessary, and made into clothing without leaving the farm.

"The skins and furs of animals were tanned by the farmer or the local tannery and converted into shoes for himself and family, and all his energies were in the direction of securing from the farm all necessary supplies. As our country has developed, the inventive genius has been called into activity, and under his inventions the American farm hand can accomplish the labor of nearly five men of the old world, and he has so divided and diversified employment as to revolutionize the former condition of things.

"Dotted over our vast country are to be found the towns and cities, with the ceaseless din of factories and the hurry and bustle of trade and traffic. The quiet of every community is disturbed day and night by the busy wheels of commerce, as the railways sweep in every direction over their steel trackage, in transit to seaboard cities laden with the rich products of the American farm. In the busy marts are found the employees of national and international steamship lines, the transportation companies, the grain elevators and the vast force of labor of shipping house and factory, all handling or reworking the raw material gathered from the forest and the field, and from which the world must be clothed, warmed and fed.

"The natural products of the soil, aided by intelligence and well-directed labor, are the great creative force, the only source from which wealth may be obtained to meet all obligations.

"The street-car fare, interest on bonds, dividends on stocks, the pension of the soldier, the fees of the professions, the dry goods and grocery bills, as well as the cost of conducting all the intricate machinery of the government, must be paid by the revenues of the soil. The product of the gold and silver mines is only valuable because of the commerce and wealth created from the farms.

"President Harrison, in his message to the Congress of the United States, intimated that the establishment of the department of agriculture, with its secretary as a cabinet officer, was at the enlightened demand of a worthy class of people, and he congratulated the people on the great results accomplished by it. In a subsequent message to the same body he referred to the marvellous growth of the farming interests. He said: 'Its growth has been from $1,363,000,000, in 1860, to $4,500,000,000, in 1891, — an increase of 230 per cent. The entire exports for the fiscal year ending June 1, 1892, reached the unparalleled amount of $1,030,000,000; 70 per cent, or, in round numbers, $800,000,000, of which were agricultural products, and exceeded the previous year by $150,000,000.'

"At the assembling of the second session of the fifty-third Congress, Dec. 4, 1893, President Cleveland corroborated the statement of his predecessor, as to the year referred to; but his message disclosed the fact that at the close of the fiscal year ending June 1, 1893, there had been a shrinkage in our exportations of nearly $20,000,000, which was on agricultural products. This could not be on account of short crops, as the President in his august message to Congress that year referred to the plenteous crops, with remunerative production and manufactory.

"In my judgment, the department of agriculture is the most important of the government; it represents greater interests than any other single department; yet, through all the history of the agricultural department, it has been characterized by timidity and lack of boldness in demanding legislation and adequate appropriations to make it effective.

"President Cleveland is correct in saying that the farmers of the United States represent nearly one-half of our people, and that the success of the farm is of direct interest to the whole country. Yet the President congratulated his secretary of agriculture, and the country at large, on the heavy reduction in expenditures recommended for his department.

"This is a non-political organization, and I think very properly so. Gentlemen will see at once the impropriety of this body trying to settle great economic questions; the Congress of the United States have tried that, and have failed. There is scarcely a question that may be raised in this body, affecting our agricultural interests, but what will have a political side to it, but let us discuss those questions without reference to their influence upon any political party. Let us take each other by the hand, and try to make common cause for our great interest.

"I do not mean by this that the farmer and agriculturist should take no part in politics. We should not for a moment lay aside or forget our duty to society and to the government. At the risk of being called politicians, it is our duty to see to it that the political atmosphere is kept clear and that the vicious classes are held in check. The good citizen will not remain behind the counter, in the field and in the shop, and permit the political trickster and common loafer to control the caucus and the convention of the party to which he belongs. Under our flag and under our constitution every citizen may exercise the right of suffrage, and he that fails is equally guilty with the dishonest politician; at the same time, we must be able to lay aside our political differences, and meet on a common level.

"Successful farming is a trade of national and international relationship to all other trades. There is no industry so sensitive to spasmodic action of social or commercial upheavals as are our productive industries.

"It is granted that labor has equal rights with capital to organize, but the right of either or any organization to disturb the channels of trade and to destroy the business interests of the country is denied; and it is hoped that the action of the President and of the federal courts will drive the agitators and the anarchists into legitimate channels to settle fancied grievances.

"Let me beg each individual member of this Congress that you will give it the full benefit of your experience, and that you will early in the session introduce any resolution covering needed legislation that you may deem advisable, and have it referred to the committee on resolutions, when appointed."

The evening session of the Congress was held in the city council chamber, which continued the meeting place thereafter until final adjournment. Several addresses were made and resolutions were offered; the roll of States was called, and the committee on resolutions was appointed, with Judge Wm. Lawrence of Ohio as chairman, Dr. J. A. Myers of West Virginia secretary, and, as the Massachusetts member, W. A. Kilbourn of Lancaster.

October 11 and 12 the sessions were taken up with reading papers, on "Agriculture in Mexico," on the "Commercial relations of American republics," "The sunshine and shadow of farm life," "An American marine," etc., which were ably treated and intelligently discussed; in the presentation of many resolutions covering a variety of subjects, and in the re-election of the old board of officers for the year ensuing.

Resolutions "to secure reciprocal trade between the United States and the Spanish-American Republics," in favor of "railroads as a factor in progress," and "that there should be mutuality of interests between them and the people," for "a provision in the future to defray expenses of members," "in favor of an elective tax," "against further issue of bonds of the United States," "against vicious advertising in the newspapers of the land," "for the regulation of taxation," "in favor of payment of sugar bounties by the United States," protests "against beef trust," "against the importation of shoddy goods," "for the extermination of the gypsy moth," and numerous others, were offered and referred to the committee on resolutions.

An interesting incident of the Congress, and worth relating, was the exhibition, by a Georgia member, of a silver cup which was presented to George Washington in 1790 by the South Carolina Agricultural Society for raising the largest jackass; a picture of the jackass was engraved on the side of the cup.

The question which occupied more of the time of the Congress than any other was the "silver question," brought before that body by resolutions variously worded, and which was ably discussed and finally disposed of by vote in favor of the coinage of both silver and gold without mention of ratio of values.

On Sunday the delegates, by special invitation of Rev. Mr. Hawthorne of the First Baptist Church of Atlanta, attended divine service, the church being filled. Dr. Hawthorne in his sermon said: —

"I am confident that among the men who till the soil of this country there is more incorruptible integrity than can be found in any other element of our population. For more than two-thirds of a century agriculturists dominated the government and social life of the nation. It requires no prophetic gift to see that a return of the agricultural classes to power would result in a revival of that virtuous simplicity and uncompromising integrity which characterized the American people in the better days of the republic."

The sessions of the Congress were resumed the following day in the council chamber of the city, where papers upon various topics were read and discussed; the presentation of more resolutions, one of which was in favor of liberal appropriations being made by the United States government for the improvement of rivers and harbors, which was referred to the committee on resolutions, and was passed.

Papers were read on "Artificial fertilizers and middlemen," "Eve and the new Adam," "The susceptibility of animals to soil and climate," "Marketing cotton," "Farmers' wives and their needs," and "on a bounty on exports," and "aid to American shipping engaged in foreign carrying trade."

The question of where the Congress should meet in 1896 was settled by the members voting in favor of Nashville, Tenn.

It was also voted to accept the invitation of the proprietors of Fruithurst, in Tallapoosa County, Ala., for the following day, to hold a session of the Congress at that place. It was also voted that the thanks of the Congress be extended to Dr. Hawthorne for his able and instructive sermon on Sunday.

A resolution was also passed commemorative of the life, acts and worth of the late Hon. Daniel Needham of Massachusetts, a member of the Farmers' National Congress for several years.

On Tuesday, October 15, in accordance with the vote of the previous day, the members of the Congress took an early train for Fruithurst, Ala., eighty-five miles distant from Atlanta. They arrived at their destination in the forenoon, where they were met by the proprietors and welcomed to Fruithurst. It is worthy of remark that two of the prominent proprietors of the Fruithurst Fruitery and Winery Association were Yankees, — one from Massachusetts, the other from Connecticut.

The Congress held a session at Fruithurst in the shade of an oak grove, were photographed, enjoyed the pleasure of an Alabama barbecue, were shown over the settlement, registered names in a visitors' book, and enjoyed the outing very much. As we gathered at the railway, waiting for the train to take us to Tallapoosa, where we were to take supper, speech-making was indulged in, and the visit to Fruithurst closed with cheers and good feeling all round.

At Tallapoosa our hosts escorted us to the Lithia Hotel, a fine large modern house, where we took supper and spent a social hour. The train which was to take the party back to Atlanta was greatly behind time, so that it was midnight when it reached its destination.

Wednesday, October 16, was the last day of the Congress. Many resolutions sent to the committee on resolutions were not reported to the full body, as they were not deemed of sufficient importance to take up the time of the closing hours of the session. All the important matters were considered, discussed as time would permit and then disposed of. More papers were read, and among them one on nitre as a fertilizer; congratulatory resolutions were passed, and at last the business for which the Farmers' National Congress had been convened was at an end; a motion to adjourn *sine die* was made and carried; the president's gavel came down, and he announced that the Congressional session for 1895 had ended.

Members grasped each other's hands, bade adieu to their co-laborers, and many started for home immediately.

The delegates from Massachusetts were accorded honorable consideration by the Congress: Mr. Avery was made a vice-president, Mr. Kilbourn a member of the committee on resolutions, Mr. Candage was made chairman of a committee to confer with the committee of the National Grange, Patrons of Husbandry and others, at Worcester, Mass., Nov. 14, 1895, and Mr. Brooks was accorded honorable consideration on the floor.

After the close of the Farmers' National Congress the members that remained in the city had opportunity to visit the International Exposition and to attend the Good Roads Parliament, where they were welcome and made members of that body.

It may not be out of place in this report to give a short account of the city of Atlanta and its wonderful growth and thrift.

Atlanta is the capital of Georgia, is situated upon the ridge which divides the Atlantic from the Gulf coasts, some eleven hundred feet above the sea level. It is one hundred and seventy-one miles from the city of Augusta and three hundred from Savannah. Its climate is dry and mild, with a mean annual temperature of 64° F. The summer heat is dry and not excessive, and sunstroke is never known there.

In 1860 Atlanta was a town of some six thousand people, living in unpainted wooden houses, which General Sherman, on "his march to the sea," in 1864, laid in ashes. In 1895 it had an estimated population of one hundred and ten thousand, one-third of whom were negroes. It is a great railway centre, one of the largest and most progressive cities of the South, its enterprise having won for it the name of "the Chicago of the South."

Northern and Western capital have greatly aided in its development. Its fine public buildings, its more than seventy miles of paved streets lighted by electricity and equipped with electrical railways, its factories, machine shops and foundries, its banking and commercial houses, its fine hotels and residences, its pure water and system of drainage, its colleges and schools, make it not only a thriving business centre but a desirable place of residence and a city of refinement and culture.

It has seventy churches, a public-school system consisting of twenty grammar, two high and several private schools. Other educational institutions are the Atlanta University, for the education of colored men and women; Clarke University, for students without regard to sex or color, attached to which is the Gammon theological department; Spellman Seminary, for women and girls; a Baptist Seminary, a School of Technology, Georgia Military Institute, two medical colleges, two business colleges and a young men's library of some ten thousand volumes.

It is to Atlanta, with the influences radiating from it, that we may look for the new life and vigor for the regeneration of the South, and create a new state of things for the whole people — white and black — of the former slave States. No other place in the South is freighted with such possibilities for the good of that part of our country as are contained in the wealth, enterprise, educational development and broad-mindedness of the people of Atlanta.

For location, salubrity of climate, good water, modern conveniences and thrift, Atlanta surpasses the other cities of the South. Her people were wise in discerning "the day of her visitation," and in welcoming in men and money from the North and West to aid in raising from the ashes of the old town this new and attractive city, of which they have just cause to feel proud.

Probably no other city of the South could have at this time accomplished what she did in the matter of the Cotton States Exhibition of 1895. The exhibition drew large numbers to Atlanta, who carried away with them to their homes in the North and West a far better idea of the South than could otherwise have been obtained by them. The fact of their coming to meet and greet their brethren of the South will prove of great advantage not only to them but through them to the whole country.

Time has softened, and is still softening, the old antagonisms once existing between the people of the free and the former slave States. This is manifest in the cordiality with which the people of the South meet and greet Northerners, and especially is it the case with the old officers and soldiers of the late confederacy. They are loyal Americans to-day, and are as proud of their country's greatness as are we of the North. This is as it should be; and we believe that the Farmers' National Congress is doing grand work in that direction as well as for the interests of agriculture, and should be maintained and aided with proper substantial support of all the States of the Union.

Respectfully submitted,

JOHN G. AVERY.
W. A. KILBOURN.
ETHAN BROOKS.
R. G. F. CANDAGE.

JAN. 12, 1896.

ANNUAL REPORT

OF THE

BOARD OF CATTLE COMMISSIONERS,

IN ACCORDANCE WITH SECTION 51 OF CHAPTER 491
OF THE ACTS OF 1894.

JANUARY 10, 1896.

REPORT

OF THE

STATE BOARD OF CATTLE COMMISSIONERS.

To the Honorable Senate and House of Representatives.

In accordance with the requirements of section 51 of chapter 491 of the Acts of the year 1894, the Board of Cattle Commissioners begs to present the following report of its work for the year 1895.

In the report of this Board presented to your honorable body on Jan. 10, 1895, and printed as Public Document No. 51 of that year, an extended report was given of the work of this Board conducted under the law of 1894 (chapter 491) up to Dec. 15, 1894. The law of 1894 as a whole has continued to be the basis of the work of this Board during the year 1895, except in so far as certain sections of that act were changed by an act passed by the Legislature of 1895, being chapter 496 of the Acts of that year.

At the time of the submission of the last report, the work of this commission was being conducted under the following heads: —

First. — The general direction and supervision of the large corps of inspectors of animals and provisions appointed by the cities and towns under the provisions of that act.

Second. — The examination of all reported cases of animals suspected of being afflicted with the contagious diseases enumerated under that law, other than tuberculosis.

Third. — The examination of neat stock for the detection of the presence of tuberculosis, the work in tuberculosis being the main work of the commission. This division of the work was being conducted in four different ways: —

1. The examination of all cases quarantined by local inspectors, suspected of being tuberculous, reports of which were received by the Board.

2. The examination of animals coming into the markets of Brighton, Watertown and Somerville for sale.

3. The examination of animals coming from without the State, upon special permit.

4. The systematic examination of all animals within localities specially designated and quarantined by the Board for that purpose.

At the time of the making of the report of last year, the Board was making all examinations of neat stock for the presence of tuberculosis with the aid of the diagnostic agent known as tuberculin, this work having been begun on Oct. 4, 1894, as stated in the report of that year.

Inspectors.

Under the provisions of sections 1 and 2 of the law of 1894, the cities and towns of the Commonwealth are obliged to appoint annually, in the month of March, one or more persons to be inspectors of animals and provisions. These inspectors have general supervision of the matter of the inspection of domestic animals within the limits of their cities or towns, and are under the supervision of the Board of Cattle Commissioners.

The law further provides that each city and town shall send to the Board of Cattle Commissioners, on or before the first day of April, a true and correct list of the duly appointed and qualified inspectors of animals and provisions, which notice shall give the name and address of each such inspector, and his usual business occupation, as far as the same is known. Under this provision three hundred and fifty-three, or all, of the cities and towns have appointed four hundred and fifty-eight inspectors, whose business occupations, so far as they are given, are as follows : —

Farmers,	241
Veterinary surgeons,	47
Butchers,	7
Grocers,	11
Trader,	1
Chiefs of police,	2
Blacksmith,	1
Retired sea captain,	1
Market gardener,	1
Street commissioner,	1
Cattle dealers,	4
Health officers,	4
Provision dealers,	5
Painters,	5
Cow doctor,	1
Wood and coal dealers,	3
Meat peddler,	1
Carpenters,	2
Electrician,	1
Lumber dealer,	1

Poultry raiser, . . .	1
Shoe shop, ...	1
Town clerk, ...	1
Sealer of weights and measures, ...	1
Contractor, ...	1
Undertaker and barber, .	1
Expressman, . . .	1
Milkman, ...	1
Tax collector, . . .	1
Laborer, ...	1
Axe maker, ...	1
Superintendent town farm, .	1
Deputy sheriff, . . .	1
Retired butcher, . . .	1
Fish dealer, ...	1
Sawyer, ...	1
Drivers of retail meat wagon,	2
Coal dealer, ...	1
Retired railroad conductor, .	1
Inspector, ...	1
Assessor, ...	1
Salesman, ...	1
Cattle broker, . . .	1
Auctioneers, ...	2
Clerk, ...	1
Dealer in horses and carriages, ...	1
Veterinary student, . .	1
Market man, . . .	1
Sole cutter, ...	1
Janitor, ...	1
Occupation not given, . .	86
Total, ...	458

Under the law of 1894 the duties of these inspectors consisted in the examination, at the time of slaughter, of all neat stock slaughtered at slaughter houses licensed under the provisions of law; the regular inspection of all neat stock within the limits of their cities or towns, at such time as the Board of Cattle Commissioners should designate; and the further inspection from time to time of all animals suspected of having any of the contagious diseases named in the act.

Under the provisions of chapter 496 of the Acts of the year 1895, these duties were extended by requiring that these regular inspections should include the examination of all sheep and swine, as well as neat cattle, as was formerly provided. This law further required that the carcasses of all sheep and swine slaughtered at licensed slaughter houses should be subject to the same systematic examination formerly required in the case of neat cattle only.

In this connection the Board desires to state that, while it has made a widely extended and very thoroughly conducted examination of all reported cases of tuberculosis among sheep in this State, it has as yet been unable to demonstrate its presence among them.

While this has been true in Massachusetts, it is right to say, here, that authoritative reports of the discovery of tuberculosis in sheep have been made, from time to time, as follows: —

The records of the Copenhagen slaughter houses, for the years 1890 to 1893 inclusive, show that, out of 337,014 sheep, 1 was found showing evidence of tuberculosis. The records of the Berlin slaughter houses for 1892 and 1893 show that, out of 335,949 sheep slaughtered, 15 showed evidence of tuberculosis.

In the case of swine, the Board, some time prior to the passage of this law, issued instructions to inspectors to ascertain as far as possible to what extent tuberculosis existed among this class of animals in their districts. The inspectors were asked to make post-mortem examinations whenever the opportunity offered, and to report the results of those examinations to the Board. In accordance with this request, many communications were received stating that tuberculosis had been found, and many specimens were sent to the laboratory showing unmistakable lesions of the disorder as existing in the lungs, livers and entire lymphatic system of these animals.

While this state of affairs was well known to exist, the Board has always considered that the difficulties surrounding the examination of live swine, for determining the presence in them of tuberculosis, were so great as to amount to an impracticability, in the cases of the local inspectors; and it has never, therefore, issued instructions to those inspectors as to methods to be pursued in examining these animals for that disease. The Board has realized, also, that the danger of communication of the disease from swine to other animals and to man is very limited, because of the fact that, so far as man is concerned, the only product of these animals eaten is derived from the flesh, and that in all cases, except among a certain portion of our German population, this product is so thoroughly cooked before being eaten as to kill the germ of tuberculosis; and, further, in regard to the transmission of the disease from swine to other animals, that the way in which swine are kept is one that prevents, of itself, any great liability of the extension of the disease to cattle; and, above all, that the life of swine is so short that any danger which may exist in this direction is naturally reduced to a minimum.

Up to March of this year, the regulations issued by this Board to inspectors required them to make two regular inspections of neat cattle in each year; the first one to be made during the month of March, or just before the animals are turned out to pasture, and the second one to be made in October, or as soon thereafter as the animals come in from pasture.

The returns coming from the inspectors under this order were so few and unsatisfactory that the commission felt that if a longer time were given a better result might be reached, and that, at any rate, if the required examination should be limited to one in each year, the expense to the cities and towns would be considerably reduced, while the results obtained would not be any less valuable; and accordingly, on March 25, 1895, the following general order was issued: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
SECRETARY'S OFFICE, 52 VILLAGE STREET, BOSTON, March 25, 1895.

To Inspectors of Animals and Provisions.

GENTLEMEN: — You may possibly remember that when the regular examinations of herds of neat stock were first begun, under the direction of this Board, four such inspections were ordered to be made in each year.

Experience with this order very soon developed the fact that it would be impossible for the inspectors to properly and thoroughly make so many examinations within the given time; and an order dated September, 1893, was passed by this Board, directing that "hereafter inspectors be ordered to make two thorough examinations of cattle in each year."

This same order was, in substance, repeated by the enlarged commission, who, in a circular letter communicated to all of the inspectors on July 19, 1894, issued an order directing that "hereafter inspectors be ordered to make two thorough examinations of cattle in each year: one during October, or as soon thereafter as animals come in from pasture; the other during March, or just before the animals are turned to pasture. Reports of the results of these examinations, upon the proper blanks, must reach this office on or before the fifteenth day of December and the fifteenth day of May in each year. That inspectors be also ordered and advised to make inspections of any herds or of any animals within their district whenever any emergency arises, or whenever in their judgment, because of numerous changes or otherwise, it is better for the service for them to do so."

It is under this order that the work has been done during the past winter and up to this time.

Now, the further experience has developed the fact that two complete inspections cannot be accomplished by the inspectors throughout the State within the given time, the inspection directed to be finished by the 15th of December not yet being completed. This Board is, therefore, of the opinion that the objects sought by the law will be more fully and properly reached by again decreasing the number of inspections to be made, thus allowing time for a more thorough and careful examination of the animals than is now possible in a great number of the towns and cities; that is to say, they feel that one thorough examination, made through each winter, *with a continued subsequent examination in special cases and under certain conditions*, will succeed in discovering a greater per cent. of the tuberculous animals than can be found in the two hurried examinations; therefore: —

At a meeting of the Board of Cattle Commissioners, held on the fifteenth day of March, 1895, it was *Voted*, That inspectors will hereafter make their examinations of neat stock in conformity with the following order: —

General Order No. 6.

Hereafter inspectors will make one thorough, regular examination of all neat stock in each year. This examination shall commence in October, or as soon thereafter as animals shall be in from pasture, and be continued with all proper dispatch until finished. Carefully made reports of the results of this examination, upon the proper blanks (Form No. 1), must reach this office on or before the first day of May in each year. Inspectors are also ordered to make further inspections of any herds or of any animals within their district whenever any emergency arises, or whenever in their judgment, *because of numerous changes or otherwise*, it is better for the service for them to do so.

FREDERICK H. OSGOOD, *Chairman*,
CHARLES P. LYMAN, *Secretary*,
MAURICE O'CONNELL,
LEANDER F. HERRICK,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

Under the provisions of the law of 1894 it was made the duty of all inspectors to quarantine every domestic animal which the inspector had reason to believe was infected with a contagious disease, the animal to remain in quarantine until examined by this Board, and released or condemned, as the case might be. Early in April, the appropriation for the work of this commission having been practically exhausted, the following order was issued to inspectors upon April 9, relating to animals placed in quarantine: —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Secretary's Office, 52 Village Street, Boston, April 9, 1895.

To Inspectors of Animals and Provisions.

Gentlemen: — Inasmuch as the temporary appropriation made for the uses of this commission by the present Legislature is nearly exhausted, we cannot at present carry on the work of examining such neat stock as you may see fit to place in quarantine, and pay for it if found diseased, until further appropriation is made. You are therefore hereby notified that any neat stock that you have already quarantined, and which has not yet been condemned by the Board, or that you may hereafter quarantine as being in your opinion tuberculous, will have to so remain until such time as sufficient money is so appropriated. When such further appropriation is made, you will be promptly notified of the fact by us.

Frederick H. Osgood, *Chairman*,
Charles P. Lyman, *Secretary*,
Maurice O'Connell,
Leander F. Herrick,
Charles A. Dennen,
Board of Cattle Commissioners.

After issuing this order the Board ceased to make further examinations of animals placed in quarantine until after June 4, when a further appropriation was made.

Upon April 9, at the time this order was issued, nine animals were in quarantine. Upon June 4 there were in quarantine, awaiting examination, eighty-six animals. The cost of keeping these animals in quarantine from April 9 to June 4 fell entirely upon their owners, and was the occasion of a considerable amount of complaint and hardship. The commission, however, was unable to remedy this, because under the law it had no authority to pay the expense of maintaining such animals in quarantine until after they had been examined; and it had no authority to incur the expense attendant upon the making of these examinations.

The passage of the law of 1895, while not making material changes as to the general administration, did change, in certain details, a large number of sections of the law relating to the administration of the work of the commission, which involved an entire alteration of the system under which the work was done. This required an entire remodelling of all general orders of the Board and of all the forms and blanks theretofore used, and it was not until late in July that this work was accomplished.

Upon July 22 the following instructions were issued to all inspectors of animals and provisions throughout the Commonwealth: —

COMMONWEALTH OF MASSACHUSETTS.

Board of Cattle Commissioners,
Secretary's Office, 52 Village Street, Boston, July 22, 1895.

To Inspectors of Animals and Provisions.

We send you herewith pamphlet containing all the laws now in force relating to the suppression of contagious diseases among domestic animals, being the law of last year under which you have been operating, as affected by the legislation of 1895. The laws contained in this pamphlet, together with such regulations and instructions as you receive from time to time from this Board and from the board of health of your city or town, will constitute the basis of your work as inspectors in the future.

Your appointment will be made by the same authorities as last year, to wit, the mayor and aldermen of cities and the selectmen of towns. As soon as you have been appointed, it is your duty to take the oath to faithfully perform the duties of your office.

While you have been appointed by your city or town authorities, the Board of Cattle Commissioners has the power to remove you from your office whenever in the opinion of this Board you neglect or refuse to properly perform the duties of your office, and in such case a new appointment will be made from this office.

While the service of the inspectors during the past year has been a great improvement over the work of the previous year, it has not been uniformly satisfactory throughout the State, and you are directed throughout your city and town to conform to the law and the regulations and orders issued by this Board. We therefore request you to carefully study the law bearing upon the matter, and to strictly carry out the instructions contained in this circular and all future orders.

Inspectors in cities or towns affected by chapter 476 of 1895 will deal directly with the auditor's office at the State House, and not with this commission, in relation to the provisions of that law.

It is made your duty, by the provisions of sections 3 and 42, to obey, carry out and enforce all orders and regulations issued by the board of health of your city or town or by the Board of Cattle Commissioners or any of its members, in the discharge of its or their duties.

Your attention is specially called to section 4 of the law herewith, which is section 1 of chapter 496 of the laws of this year. This law extends your duties in relation to inspection beyond that of last year. Under the previous law it was your duty to make regular inspections of all neat cattle within the limits of your city or town. This duty still remains in force. You will make this inspection in accordance with General Order No. 6, issued by this Board, March 25, 1895, which is as follows: —

General Order No. 6.

Hereafter inspectors will make one thorough, regular examination of all neat stock in each year. This examination shall commence in October, or as soon thereafter as animals shall be in from pasture, and be continued with all proper dispatch until finished. Carefully made reports of the results of this examination, upon the proper blanks (Form No. 1), must reach this office on or before the first day of May in each year. Inspectors are also ordered to make further inspections of any herds or of any animals within their district whenever any emergency arises, or whenever in their judgment, *because of numerous changes or otherwise*, it is better for the service for them to do so.

The law further requires you to make regular and thorough inspections of sheep and swine, as well as neat cattle. You will make this inspection at the same time that you make the inspection of neat cattle, under General Order No. 6. The Board has no special instructions to give you in regard to the inspection of sheep. It has no knowledge that tuberculosis exists in sheep, nor can the Board point out to you any particular method which it desires to have you follow to assist you in detecting tuberculosis in swine when alive.

Under section 5 it is your duty to keep a complete record of all inspections made by you upon the stub accompanying form No. 1, '95. In making this record you will be careful to make it complete both in the stub and in the return of such inspection, which should be made regularly to this commission, upon the proper blank (No. 1, '95), being careful to state particularly as to each animal. A separate page of these returns should be mailed to this office, corresponding with each certificate of inspection which you deliver to the owner. There should be one of these certificates returned for each owner or herd. Under the provisions of section 6 it is made your duty to deliver to the owner, or person in charge, a certificate covering the animals inspected by you where you fail to find any contagious disease present. This certificate, under the present law, includes not only neat cattle but also sheep and swine. *You should impress upon* *the owners of such animals that this certificate is not a guaranty that these animals are free from disease, or that they will remain so in the future, but that it is simply a certificate based upon a physical examination made by you, showing that upon such examination you fail to detect the presence of any contagious disease.* This certificate should be made upon form No. 2, '95, which will be furnished you by this office, and a careful record of the facts contained in such certificate should be entered in the stub thereof.

It is also provided under the law enacted this year (see section 4) that you shall inspect barns, stables and other premises where animals are kept, whenever directed so to do by this Board. Separate forms will be furnished you later, with instructions in relation to this inspection.

It is also your duty to quarantine any animal whenever you are directed so to do by the board of health of your city or town or by this Board or any of its members. All quarantines imposed by you must be upon the premises of the owner or of the person in whose charge the animal is found, unless you have specific directions to the contrary from this Board or from your board of health. In imposing these quarantines great care should be taken by you, because every such animal, when properly quarantined, is deemed to be diseased so long as the quarantine lasts, and severe penalties are imposed for the breaking of any such quarantine (see section 34). Forms for these quarantines will be furnished you by this Board, and we desire to call your especial attention to these and to the manner in which the quarantine should be imposed. When you find an animal which you suspect or believe is affected with any of the contagious diseases named in the act, you should first ascertain, if possible, the owner of the animal, and to this end you should make yourself familiar with the cattle and other animals within your city or town. If you are unable to find the true owner, you will quarantine the animal, and direct your order to the person whom you find to be in possession of the animal at the time, first ascertaining from him, as far as possible, his control over the animal. Having ascertained these facts, you will then proceed to impose the quarantine.

You will note that the book of quarantine blanks which is furnished you contains three different kinds of blanks, printed upon different colored paper, and you will find upon the inside cover of this book brief directions as to these blanks, and upon what animals they are to be used.

Whenever an animal which you desire to quarantine is a cow in milk which you suspect or have reason to believe is tuberculous, you will use the form printed upon pink-tinted paper (*No.* 3 *a*, '95), *but this form should never be used upon any other animals.* Under the law now in force (section 27 of the pamphlet herewith) the Commonwealth will pay the actual expense of quarantine of all cows in milk which is incurred after the tenth day from the date when the quarantine is imposed, because in such case the owner is forbidden to use the milk, and therefore while the quarantine lasts he is subjected to a loss from his failure to market this product. In the case of dry cows, bulls, oxen and all other animals, except when your quarantine is imposed in pursuance of a direction from this Board, you will, in quarantining such animals, use the form printed on white paper (No. 3 *b*, '95). In this case the owner suffers no loss while the animal is in quarantine, because there is no immediate product which he is prevented from selling, and here the expense of the quarantine is borne by the owner, as heretofore.

Whenever you are directed to quarantine any animal by this Board or any of its members, either by general order or special directions, it is made your duty to quarantine such animal, irrespective of any judgment that you may have as to the existence of disease (see section 7). In such case you will use the form printed on blue paper (No. 3 *c*, '95), unless you receive specific directions to the contrary. The animals quarantined by order of the commission will usually be animals which have been brought from without the limits of the Commonwealth contrary to the quarantine regulations imposed by the commission, and, although such animals may be cows in milk, the owner is not forbidden to dispose of such milk, because the animal is not quarantined as actually suspicious of being tuberculous.

Your attention is specially called to General Order No. 9, issued by this Board July 8, 1895, relating to cattle brought into this Commonwealth. You will carefully note the contents of this circular, and see, so far as possible, that its terms are carried out within the limits of your city or town. If you have any reason to believe that any person proposes to bring any neat cattle into your city or town without obtaining a permit for the same, you will send to this office all the information that you can obtain bearing upon the matter. If you find that any cattle have been brought into your city or town contrary to the regulation, you will quarantine all of the same upon the premises of the owner or person in charge, using quarantine form No. 3 *c*, '95, printed on blue paper. In case the permit issued by this Board for entry of any such cattle within the limits of your city or town orders the owner or consignee to notify you upon the arrival of such animals, you will inspect all of the same as soon after their arrival as practicable. In such case your duty is simply to see that each animal is accompanied by a permit issued by this Board. If the permit is accompanied by a certificate of a veterinarian, which in all cases must be attached to the permit of entry, you will examine the animal, and see whether it corresponds with the description contained in the permit and certificate. If you find that it so corresponds, you will detach the veterinarian's certificate from the permit and indorse upon the bottom of said certificate the date and place of release, which you will sign and deliver to the owner or consignee. *You will fill out the corresponding certificate upon the bottom of the permit and return the same immediately to this office.* If you find that such animal does not correspond with the description in the permit and certificate, or if the permit is not accompanied with a certificate, you will immediately quarantine said animal, using the form No. 3 *c*, '95, printed upon blue paper, and forward to this office at once the duplicate, together with the permit of entry.

You should make yourself thoroughly familiar with the orders of quarantine in each case, so as to follow them intelligently. All of the blanks contained in these orders of quarantine should be carefully filled out. See that the date corresponds with the day when the quarantine is actually made, and when the order of quarantine is delivered to the owner, or served as provided by law. *Always write in the name of your city or town and the name of the owner in full, writing in his given name, and not the initials, if you know it.*

You will name the place where the quarantine is imposed, and give a description of the premises which will be sufficient for identification. *You must quarantine only one animal on a single blank, and you should write upon the blank an accurate description of the animal, giving all her distinguishing marks, so that the animal can always be easily and surely identified by the description contained in your order of quarantine.* You will also fill out the stub for the original order of quarantine, seeing that this is also accurately and carefully done. The original order of quarantine is to be served as directed in section 8. *If the owner is known to you and can be found, you should always deliver the original order of quarantine to him in person.* If he cannot be found and you know his usual place of abode, you will leave it at such place, giving it, if possible, to his wife or some member of his family, and instruct him or her of the importance of the order, and his or her duty to see that the owner receives it. In such case you should afterwards ascertain from the owner whether he received the order of quarantine, and see that he is informed of it. If the owner cannot be found or his residence located, you will deliver the notice to the person in charge. In such case you will write in the name of the person in charge. This should not, if it can be avoided, be delivered to ordinary hired help or men of a similar character about the premises.

If you cannot find either the owner or anybody in charge, you will post the order of notice upon some conspicuous place upon the barn or building where the animal is quarantined. This should not be done, however, except where it is practically impossible to find the owner or person in charge. In delivering the original order of quarantine to the owner, you should call his attention to the importance of his observing the quarantine, and especially to the section of the law bearing upon the matter which is printed upon the back of the order of quarantine.

You will note that the orders of quarantine are printed in duplicate, the original and duplicate following each other in the book. *This duplicate should be filled out to exactly correspond with the original.* This duplicate is to be sent to the office of this Commission, 52 Village Street, Boston, and *must be sent at once upon imposing the quarantine* (see section 9). The duplicate contains a form of return of service upon the back, which it is your duty to carefully follow. Accurate instructions are given under the return, stating how you should fill out the same, and these must be strictly complied with. Be sure to fill out and sign this return on the back of duplicate before mailing it to this office. At the same time that you send this to the Board of Cattle Commissioners you should detach and deliver to the board of health of your city or town the notice of quarantine which is printed by the side of the duplicate order of quarantine. The same rules are to be followed as to all the several forms of quarantine, except that the blank spaces to be filled in on these quarantines differ slightly.

Besides the quarantine imposed by your orders, you may receive, from time to time, orders of quarantine issued by this Board, sent to you for service. In such case the order of quarantine will be filled out at this office. It will be simply your duty to serve the same. In doing this you will proceed in the same manner as in the case of quarantines imposed by you.

You have no power to remove any quarantine imposed by you except upon the written order of this Board, or one of its members, or of the board of health of your city or town. When you have forwarded notice to this Board and to the board of health of quarantines imposed by you, and have served the order upon the owner or person in charge, or posted the same as above directed, it will be your duty to refrain from giving any information regarding the matter to any person whatsoever. While it is your duty to obey all orders issued by the board of health of your city or town, such orders are superseded by orders issued by this Board, in so far as they refer to the same matter (see section 40).

Under section 10 you are authorized to inspect the carcasses of all slaughtered animals, meat and other food products therein designated. You will act entirely in conjunction with your board of health in this matter, except as to matters of animals and meat inspected for the purpose of detecting the presence of a contagious disease. Whenever, upon the inspection of any carcass, which, within the meaning of this act, is defined to be the dead body of an animal before any of the vitals or other portions of the body are removed, you find that any portion of the body or any of the organs therein contained are affected with tuberculosis or other contagious disease, you will condemn the whole of the carcass, see that it is properly buried or otherwise safely and effectually destroyed, and send a notice of the fact to this office (see section 11). If, however, at the time of seizure the owner of the property notifies you in writing that he desires to appeal to the board of health, you will immediately notify such board of the appeal, and will retain the custody of the carcass, meat, etc., until such appeal is decided, which decision will be final.

You are also authorized, under section 12, to inspect veal. As to this inspection you will also act entirely with your local board of health.

Power is given you, under section 13, to enter, for the purpose of making inspections, upon any premises or into any building where animals, carcasses, meat, etc., are kept, and any person who interferes with you or prevents you from making this entry or examining such animals, meats, etc., is subjected to a heavy penalty for so doing. If this right is denied you, or you are prevented or interfered with in the performance of your duties, you should first demand entrance to the premises, or the disclosure of the secreted animal or article, making such demand, if possible, in the presence of some third party as a witness. If such entrance is refused, you will immediately notify this office, stating all the facts and the names of the witnesses who are present. *Do not in any case use force.*

Your attention is further called to sections 17 to 22, inclusive, of the pamphlet herewith, which are sections 3 to 8, inclusive, of chapter 496 of the Acts of 1895, relating to the matter of the inspection of carcasses and slaughter houses. These sections are substantially the same as last year, except that they require the inspection of carcasses of sheep and swine as well as of neat stock. The requirements of these sections will form an important branch of your duties. You are urged to see that there are no infractions of this law; and whenever you have any knowledge that any person is carrying on an establishment for the slaughter of neat cattle, sheep or swine without obtaining a proper license, or that any person is slaughtering upon his own premises any of such animals without inspection, contrary to the provisions of section 21, you will immediately notify this office and your board of health of the fact, giving details as fully as possible. Every licensed slaughter house is obliged to state the class of animals which it intends to slaughter, the days on which it is the intention to slaughter, either in its application or by a subsequent written notice, of which you are directed to keep yourself informed (see sections 18 and 19). The license which is issued to each such slaughter house will state all the kinds of animals which the licensee is authorized to slaughter, and you will see that no animals are slaughtered on such premises except those designated in the license. By section 20 it is made your duty to be present on the days of slaughter, and *inspect at the time of slaughter* all neat cattle, sheep or swine at such establishment. If there is more than one inspector in your city or town, it is the duty of your board of health to divide the duties between you as to the slaughter houses.

Your attention is especially called to the wording of this section, which requires you to inspect *at the time of slaughter.* This means that you must in all cases inspect the animal before any of the vitals have been removed; *and you will not permit the owner or persons slaughtering to remove any of the vitals and set them apart for your subsequent inspection.* Where practicable, arrangements may be made between you and the proprietors as to the time of day when it will be necessary for you to be present.

You will also inspect *at the time of slaughter*, as defined by section 21, neat cattle, sheep and swine slaughtered by persons not regularly engaged in the business, whenever you receive reasonable notice from them of their intention to slaughter. This section has been slightly changed by the act of this year, which permits the slaughter without such inspection of calves less than six months old. This section also permits the slaughter without inspection of animals which have received a certificate of health from an inspector within six months. You will see that all animals slaughtered not coming within these two exceptions are inspected by you.

You will keep careful record of all these inspections, and make proper return of the same to this office upon the prescribed form, No. 6, '95, which will be furnished you. You will note the directions at the bottom of this form, and see that the certificates are regularly forwarded, and that they fully cover all this class of work conducted by you. This commission will not deem that any inspector has properly performed his duties who fails to carefully and conscientiously attend to the slaughter-house inspection and rendering of returns.

Whenever you find the carcasses of any neat cattle, sheep or swine to be infected with tuberculosis or other infectious disease, you will proceed as directed in sections 10 and 11.

You will also note the provisions of section 22 as to penalties incurred by persons who fail to cause their animals to be properly inspected, or who deal in meats of animals not so properly inspected.

Your attention is further especially called to the provisions of sections 29, 30 and 35, and you will call the attention of all veterinarians within the limits of your city or town to the requirements of law contained in these sections.

You will note the provisions of sections 38, 39 and 40, relating to regulations issued by this Board, and you will be governed by the requirements in such regulations.

Under the provisions of section 45, this Board, or any of its members, are authorized to kill animals which they deem to be affected with a contagious disease, when they deem that the public good requires it. Animals will be killed upon written orders issued by this Board, or one of its members, which orders may be directed to some agent of this Board, or to you or such other person as may be therein designated. In case you are named therein, it is your duty to strictly obey all directions contained in such order, both in the killing and in the disposal made of the carcasses. You will see that all orders of this Board, or of your board of health, regarding the cleansing and disinfecting of premises are promptly and thoroughly carried out. Whenever you receive any such order to destroy any animal, you will kill it yourself, or cause it to be killed by some other person *in your presence;* and in such case you will return a proper certificate to this office that such animal has been properly killed and disposed of. The majority of such animals so ordered killed will be neat stock destroyed as tuberculous. If such order is directed to you, you will see that all the requirements of said order, and of the certificate of ownership and valuation of the animal accompanying the same, are fully complied with. Full directions as to the same will be sent you with the order of killing. In case such order of killing is directed to an agent of this Board or other person, it will be your duty to accompany such agent or person, pointing out the animal called for in the order, and otherwise assisting him in the performance of his duty.

No compensation is to be paid to any person for any animal killed, except in the case of cattle affected with tuberculosis, and then only when such animals have been killed by order of this commission or one of its members, and when same has been owned within the State six months continuously prior to the order of killing.

In cases where the carcasses of any animals are destroyed by your order or that of the board of health, upon inspection at the time of slaughter, no compensation is paid for the same.

In case you act as appraiser in determining the value of any neat stock destroyed as tuberculous, your attention is called to the provision relating to this matter contained in section 45, which is section 10 of chapter 496 of the Acts of 1895. The requirements of law of last year, which provided that the animal was to be valued at the time of slaughter, "for food or milk purposes, and without taking into consideration the existence of the disease," have been repealed, and the present law requires you to value the animal at its actual *value at the time of condemnation.*

If you have any reason to believe that any person whose cattle are killed as tuberculous has, prior thereto, by wilful act or neglect, contributed to the spread of tuberculosis, you will notify the commission of this fact, giving, so far as possible, your reasons for so believing.

Forms for records to be kept by you, and of returns to be made, will be furnished you from time to time. These forms will correspond in a general way to those required last year. You are hereby directed to immediately deliver to the board of health of your city or town books of record heretofore furnished, being forms Nos. 1 and 2, relating to inspections and returns, form No. 3 being blank forms of quarantine, and blanks of form No. 6, being returns of inspection of slaughtered animals; and upon the Board receiving notice from the board of health of the return of such forms, new books, containing the forms for this year, and new forms will be furnished you in place thereof; and you are hereby directed not to use any of the forms of last year after the issue of this order.

At the expiration of your term of office as inspector it is your duty to immediately surrender all your books and blanks to the board of health of your city or town, to be delivered by them to the new appointee.

You are directed to carefully examine the provisions of this law and of the records and forms furnished you, and see that you thoroughly understand the same. You will see that these records are all carefully and thoroughly kept; and they must be at all reasonable times open to the inspection of the board of health or any member of this commission.

Frederick H. Osgood, *Chairman*,
Charles P. Lyman, *Secretary*,
Maurice O'Connell,
Leander F. Herrick,
Charles A. Dennen,
Board of Cattle Commissioners.

Address all communications to 52 Village Street, Boston.

As will be seen by reference to this order, special instructions were given to these agents in relation to the certificates of soundness required under section 2 of chapter 496 of the Acts of 1895. In view of the experience of this Board in making physical examinations and tuberculin tests, it was felt that the owners of all neat stock should be informed that the certificate which they received showed only that an inspector found no evidence of disease upon physical examination. Accordingly the certificates prescribed by the commission to be issued by these inspectors were in the following form: —

CERTIFICATE OF INSPECTION OF CATTLE, SHEEP AND SWINE.

(Section 2, chapter 496, Acts of 1895.)

To be given to the Owner or Person in Charge.

Town or city of Month, Day, 189 .

I hereby certify that I have this day examined the following animals, said to be owned by Mr. of Street, town or city of : —

Cows in milk, Bulls, Cows dry and not fatting,
Fatting, Young, Oxen, Sheep, Swine,

Upon a physical examination I find no evidence of tuberculosis or other contagious disease in any of said animals. *Inspector.*

This certificate is not based upon a tuberculin test.

Further special instructions were given to the inspectors in relation to the quarantine of tuberculous animals. Section 27 of the law of 1894 provided that: —

> When any animals are quarantined, collected or isolated under the provisions of this act, upon the premises of the owner or person in possession thereof at the time such quarantine is imposed, the expense thereof shall be paid by such owner or person in possession thereof.

Under the provisions of this law the inspectors were furnished blank forms of quarantine with which all animals suspected of being infected with any contagious disease were quarantined.

Section 9 of the law of 1895 changed this law by providing that: —

Whenever specific animals are quarantined or isolated under the provisions of sections seven, twenty-six and forty-five of this act, more than ten days upon such premises, as suspected of being afflicted with a contagious disease, and the owner is forbidden to sell any of the product thereof for food . . . the expense of such quarantine shall be paid by the Commonwealth.

Inasmuch as neither the law nor the regulations issued by the commission forbid the sale of the product of any animal quarantined, except the milk from cows, it was necessary to prescribe the use of quarantine orders, relating to such animals, differing from those that were used in the case of all others. In consequence the following order of quarantine, relating to cows in milk suspected of being tuberculous, was prescribed by the commission :—

Order of Quarantine.

(Section 7, chapter 491, Acts of 1894.)

Original.

(To be delivered to owner or person in charge.)

☞ To be used only for cows in milk suspected of being tuberculous.

Town or city of 189 .

To owner (or person in charge).

You are hereby notified that, by virtue of the powers and authority in me vested by law, I have caused to be isolated and placed in quarantine in upon your premises, to wit, the milch cow described as follows, under suspicion of having the disease known as tuberculosis, a contagious disease under the law.

You and all other persons whom it may concern are hereby forbidden to remove the same from said place of quarantine for the purpose of slaughter or for any other purpose whatsoever, or otherwise to break said quarantine, until the further order of the local Board of Health, the Cattle Commission or some one of its members.

You are notified that until this quarantine is removed said cow is deemed to be diseased. You are warned of the danger of using the milk therefrom, and are forbidden to sell or otherwise dispose of it in any market.

The Commonwealth will pay the actual expense of this quarantine which may be incurred after the tenth day, upon your returning to the Board of Cattle Commissioners a satisfactory certificate of such expense.

Inspector.

Use a separate order for each animal.

In all other cases the following form was ordered to be used: —

ORDER OF QUARANTINE.

(Section 7, chapter 491, Acts of 1894.)

Original.

(To be delivered to owner or person in charge.)

☞ To be used for all animals except cows in milk suspected as tuberculous.

Town or city of 189 .

To owner (or person in charge).

You are hereby notified that by virtue of the powers and authority in me vested by law, I have caused to be isolated and placed in quarantine in upon your premises, to wit, the following animal, under suspicion of having the disease known as , a contagious disease under the law.

You and all other persons whom it may concern are hereby forbidden to remove the same from the place of quarantine for the purpose of slaughter, or for any other purpose whatsoever, or otherwise to break said quarantine, until the further order of the local Board of Health, the Cattle Commission or one of its members.

You are notified that until this quarantine is removed said animal is deemed to be diseased.

Inspector.

Use a separate order for each animal.

In view of the fact that the regular spring inspection was not made during the past year, comparatively few milch cows were placed in quarantine. In all cases where milch cows have remained in quarantine more than ten days, the owner who desires to make any claim upon the Commonwealth for the expense of such quarantine is required to make oath and deliver to the commission a claim for expense, in the following form: —

CLAIM FOR EXPENSE OF QUARANTINE.

(Section 9, chapter 496 of the Acts of 1895.)

To the Board of Cattle Commissioners, 52 Village Street, Boston.

City or town of 189 .

DEAR SIRS: — I hereby claim from the Commonwealth of Massachusetts $ as the expense of quarantine of a cow in milk for days, and in support of the same I make the following affidavit: —

I hereby certify that during the entire period of quarantine I was the owner or person in possession of the cow in milk described as follows: ; that said cow was duly quarantined upon the day of 189 , by , upon which day the proper order of quarantine was duly delivered to me; that said cow remained in quarantine continuously thereafter until the day of ; that during all said time I did not remove said cow from quarantine or in any way break the same or disobey any order lawfully issued in regard to said animal or quarantine.

I further certify that I did not sell, dispose of or use for food the milk or any other product of said cow during all the time that said cow was in quarantine, and that since the day of 189 , *being the tenth day after the date when said cow was quarantined*, I actually expended in maintaining said cow in quarantine the sum of $ as follows: —

I further certify that all said expenses were reasonable, and were necessary for the proper maintenance of said cow.

Witness, *Owner.*

COMMONWEALTH OF MASSACHUSETTS.

ss.

City or town of 189 .

Then personally appeared the above-named to me personally known to be the person subscribing the same, and made oath that the foregoing statement by him subscribed is true, except as to such matters as are alleged on information and belief, and as to those, that he believes them to be true. *Justice of the Peace.*

Seventeen claims have been received by this commission for the expense of quarantine under this section. In the majority of these the price charged was deemed reasonable, and has been approved by the commission. The remaining claims have been held for further investigation.

The commission would further state that in all other cases where animals have been placed in quarantine the length of time during which they have been held has been less than ten days.

The Board is now only beginning to be in receipt of returns of quarantine imposed, as the result of the annual examination; but between the fifteenth day of November and the fifteenth day of December 1,011 animals have been so quarantined, and, at the present writing, these quarantine orders are being received at an average rate of about sixty per day.

The receipt, at this time, of this very large number of notices of quarantine, together with the fact that the appropriation made for the work of the Board has been exhausted by payments made and obligations incurred, brought the commission face to face with a question of considerable economic importance, the proper solution of which is difficult. Inasmuch as the inspectors are public officers, charged with the duty, imposed by law, of making regular and thorough inspections of all neat cattle, sheep and swine found within the limits of their several cities and towns, the Board has no power to prevent these inspections, nor has it the power to forbid the quarantining of animals suspected of being diseased.

Further, section 37 of chapter 16 of the Public Statutes provides that: —

> No public officer shall make purchases or incur liabilities in the name of the Commonwealth for a larger amount than that which has been appropriated by law for the service or object for which such purchases have been made or liabilities incurred; and the Commonwealth shall be subject to no responsibility for the acts of its servants and officers beyond the several amounts duly appropriated by law.

Finally, under the provisions of the law relating to quarantine the statute is imperative that the Commonwealth shall pay to the owners the entire cost of maintaining quarantined animals after the lapse of the first ten days.

In the face of this dilemma the commission have considered it more desirable to incur the expense of making the examinations as soon as possible after receipt of the notice, freeing such animals as were found not to be tuberculous, and keeping the others in quarantine until it becomes possible, by means of a further appropriation, to compensate the owners for their losses and destroy the animals.

Inasmuch as the order of this Board, issued March 25, did not require that a regular inspection should be made until October, 1895, or later, nor that the returns should be completed before the first day of May, 1896, the commission is not in possession of complete returns showing the results of a thorough inspection of neat cattle, sheep and swine throughout the State; but, up to the first day of December, returns had been received from sixty-nine towns, showing the following results: total number of herds examined, 4,769; total number of cattle examined, 26,756; total number of sheep examined, 5,412; total number of swine examined, 13,061; making the total number of all animals so far examined 45,229, with 285 cities and towns yet to be heard from.

SLAUGHTER-HOUSE INSPECTION.

Under the law of 1894 it was provided, for the first time, that the proprietors of slaughter houses and similar establishments engaged in the slaughter of cattle should take out a license to conduct such business. The result of this division of the work, to Dec. 15, 1894, will be found upon pages 16–18 of the report of this Board for the year 1894.

As will be seen, this law required licenses to be taken out only in the case of persons engaged in the slaughter of cattle. Under an amendment contained in section 3 of the law of 1895, the act of 1894 was extended to include: —

> The proprietor or proprietors of every slaughter house, canning, salting, smoking or rendering establishment, and of every establishment used for the manufacture of sausages or chopped meat of any kind, engaged in the slaughter of neat cattle, sheep or swine, the carcass or any of the meat or product of which is to be sold or used for food . . .

By the provisions of section 1 of the same law it was further provided: —

> Nothing in this act shall apply to the inspection of sheep or swine slaughtered in wholesale slaughtering establishments, or to the obtaining of a license for the slaughtering of such sheep or swine.

It will be understood, therefore, that as a result of the amendment of 1895 all establishments theretofore required to take out licenses were still subject to the same law, and the law was extended to include those slaughtering sheep and swine, unless such person was the proprietor of a wholesale slaughtering establishment.

Upon July 1, 1895, this Board issued a general order to mayors and aldermen of cities and selectmen of towns, containing the following instructions relative to the issuing of licenses: —

> Every such proprietor engaged in the business of slaughtering neat cattle must take out such license before he is authorized to do business. Wholesale slaughtering establishments are not required to take out a license for the slaughtering of sheep or swine, nor are the inspectors required to be present at such establishments to inspect at the time of slaughter the carcasses of sheep or swine (section 1, chapter 496 of the Acts of the year 1895). If, however, such proprietors are also engaged in the slaughter of neat cattle, they must take out a license to slaughter such animals as heretofore. In the opinion of this Board, a wholesale slaughtering establishment within the meaning of this act is an establishment that markets its product to the jobbing trade alone, and disposes of no single carcass or portions thereof. In all such establishments inspections are now being made by agents appointed under the laws of the United States, therefore an establishment where no such inspection under the laws of the United States is being conducted is not deemed to be a wholesale establishment by this Board.

Soon after the law of 1894 came into operation, it was found to be defective, to a certain extent, in that it failed to provide for the making of returns to this commission of the number of the several establishments so licensed to carry on this business. Accordingly the law was amended by section 4 of the law of 1895, by providing that: —

> The board or officer of every city or town authorized to issue said license shall on or before the first day of June in each year send to the Board of Cattle Commissioners a copy of every application made to them under section seventeen of this act, and shall state the doings of said board or officer upon said application; and shall further send to the Board of Cattle Commissioners the names and addresses of all persons required to make application under section seventeen, who were engaged in such business on the last day of the previous April, and who have failed to make application as provided in said section.

Under the order issued by this Board on July 1, to cities and towns, the Board gave the following directions: —

Forms of applications and licenses to slaughter will be furnished you upon application to this Board. Please notify all persons engaged in the business of slaughtering neat cattle, sheep or swine within the limits of your city or town of the provisions of this act, and request them, if they desire to conduct such business further, to make proper application in accordance with the provisions of section 3 of said chapter 496, which should be strictly complied with. In case the proprietor of any such establishment has already obtained a license to slaughter cattle for the year ending the 30th of April, 1896, and does not desire to slaughter either sheep or swine, no new application is necessary. If such person desires or intends to slaughter sheep or swine in addition, it will be necessary to make application for and obtain a new license.

Your attention is called to section 4 of said chapter 496, in relation to the issuing of licenses, which should be strictly complied with, and records should in all cases be kept by the proper board, showing the action taken by your city or town upon each application.

Your attention is specially called to the latter portion of the provisions of this section, which requires the board or officer having the matter of the issuing of such licenses in charge to send to the Board of Cattle Commissioners a copy of every application made to carry on such business of slaughtering, together with a copy of the records of the city or town, showing the action of such board or officer upon each such application. The commission deems it very important that this provision be complied with, in order that accurate records may be kept of the location of all such establishments and of the names of all persons engaged in such business.

Inasmuch as the law this year allows thirty days within which licenses must be taken out, which would expire on the fifth day of July, the Board desires you to send to it before the first day of August a copy of all such applications which have been or may be made to conduct the business of slaughtering for the year ending April 30, 1896, and of the records of the doings of your city or town officials upon the same, and also a list giving the names and addresses of all persons within the limits of your city or town, required under this section to take out a license, who were engaged in such business on the thirtieth day of April, 1895, and who have failed to make application for a license to carry on the business.

The Board earnestly requests that you will co-operate with it in this important work, and will promptly notify it of any breaches of this law, not only on the part of persons slaughtering animals, but on the part of the inspectors in failing to attend properly to the matter of inspection.

Under this provision of the law and in response to this order the Board has received returns from fifty-nine cities and towns. New forms for licenses under the provisions of the act of last year were prepared by the Board, and furnished, as heretofore, to such towns as desired them, free of charge. The form of these licenses varied but slightly from the form used and printed in the report of last year (see page 168, report of 1894).

The duty of inspecting animals at the time of slaughter in these establishments is, in but comparatively few instances, imposed upon those who are also inspectors of herds, so that a very material portion of the work of those appointed to these positions consists in the inspection at the time of slaughter of all neat cattle, sheep and swine slaughtered at these establishments. Full directions in relation to this work were given by the commission to such inspectors in the letter of instructions, already printed on pages 434–443 of this report.

Returns of this inspection of slaughter houses are required to be made by each inspector once in each month; and these returns received since the time at which the law was changed, in June last, up to the fifteenth day of December, show the following results: —

Number of cattle inspected at licensed slaughter houses at time of slaughter,	18,738
Number of sheep inspected at licensed slaughter houses at time of slaughter,	36,720
Number of swine inspected at licensed slaughter houses at time of slaughter,	2,779

It was further provided, by section 21 of the law of 1894, that wherever any person slaughtered any of his own cattle upon his own premises, other than a slaughter house, such person shall cause the carcass to be inspected at the time of slaughter, "unless such animal has been duly inspected under the provisions of this act within six months prior to such slaughter, and a certificate of health has been delivered to the owner or person in charge thereof." This law was amended to read, "unless said animal is less than six months old, or has been duly inspected under the provisions of this act within six months prior to such slaughter, and a certificate of health has been delivered to the owner or person in charge thereof."

Under the provisions of this law, therefore, all animals slaughtered by owners, other than proprietors of licensed slaughter houses, are required to be inspected, unless they come within the exception above stated. The returns from this inspection are: —

Number of cattle inspected at time of slaughter, under section 21,	508
Number of sheep inspected at time of slaughter, under section 21,	212
Number of swine inspected at time of slaughter, under section 21,	1,034
Total number of animals inspected at time of slaughter, including those inspected at licensed slaughter houses and also under section 21,	59,991

These returns are meagre, and, therefore, as indicating a non-compliance with this important although rather new provision of our laws, unsatisfactory. It is hoped, however, that in the near future, as our city and town officers become more familiar with the work required of them under it, much improvement will be made.

The following returns of diseased carcasses, found by inspectors, embrace their examination both at slaughter houses and upon the premises of owners (under section 21): —

Cattle destroyed as tuberculous,	192
Sheep destroyed as tuberculous,	8
Swine destroyed as tuberculous,	97
Percentage of cattle found infected,	1.00
Percentage of sheep found infected,	.02
Percentage of swine found infected,	2.50

It will be noted that these returns show that the carcasses of eight sheep were destroyed as tuberculous. It should be understood that these condemnations were made, so far as this Board is informed, by the inspectors, and is a statement of their opinions, unsupported by any laboratory investigation.

GLANDERS.

During the past year, as heretofore, the entire time of Commissioner O'Connell has been substantially given to answering in person the numerous calls in relation to suspected cases of glanders and farcy, received from local inspectors, health authorities and various other persons.

During the year the Board has received notification of two hundred and fifty of such suspected cases; of these, two hundred and six have been condemned and killed and forty-four have been released. All cases of this nature that have been received have been attended to, and in every case that has been destroyed post-mortem examination has shown the disease.

The condemned animals were found in the following-named cities and towns. The asterisk shows towns where same disease was found in 1894.

Abington,
* Amesbury,
Amherst,
* Arlington,
Attleborough,
Ashburnham,
* Boston,
Braintree,
* Brockton,
* Cambridge,
* Canton,
Charlestown,
* Chelmsford,
Chesterfield,
* Chicopee,
Clinton,
Dedham,
* Everett,
East Longmeadow,
Fall River,
Fitchburg,
* Franklin,
* Gardner,
* Grafton,
Groveland,
* Harvard,
* Haverhill,
* Holyoke,
* Hopkinton,
* Lawrence,
Lee,
* Lexington,
Lowell,
* Lynn,
* Malden,
Mattapoisett,
* Millbury,
*Needham,
* Newton,
* Northampton,
North Andover,
Pittsfield,
Quincy,
* Somerville,
Southbridge,
Southborough,
* Springfield,
* Stoughton,
Stockbridge,
Swansea,
Shelburne Falls,
* Taunton,
Ware,
* Westport,
Wayland,
Waltham,
Wellesley,
Webster,
* Whitman,
West Springfield,
* Worcester.

A comparison of these statistics with those given in this same connection in the report for 1894 shows that in the same number of towns there have been twenty more cases reported and forty-six more animals destroyed this year than last; and that, of the sixty-one towns reporting, thirty-one were among those reporting last year.

Three quite pronounced outbreaks of the disease have been encountered, one in Worcester, one in Fall River and one in Lynn; but it is now believed that these outbreaks have been successfully suppressed.

The commission has good reason for believing that much of the difficulty surrounding any attempt at the suppression of glanders and farcy is in the failure upon the part of some of those who make a business of treating sick horses, and who call themselves veterinarians, to report the cases that come to their knowledge. It is certainly true that practically no information of this kind is received from this source by the commission. Veterinary practitioners should be more anxious and more able than any other class of our community to be active in helping to suppress a disease which is so destructive to horses and so dangerous to mankind.

Otherwise, the commission has had the hearty co-operation of the community, the local boards of health and the police departments of the several cities and towns.

It is possible that, if it is more widely understood that sections 29 and 35 of chapter 491 of the Acts of 1894 refer to glanders and farcy as well as to some other contagious diseases of animals, the law will be more fully complied with. The sections are as follows: —

Section 29 of the Acts of 1894 provides that: —

> Every person who has knowledge of or good reason to suspect the existence of any contagious disease among any species of domestic animals within the limits of this Commonwealth, or that any domestic animal is affected with any such contagious disease, whether such knowledge is obtained by personal examination or otherwise, shall immediately give written notice thereof to the board of health of the city or town where such diseased animal or animals are kept, and for failure so to do shall be punished by a fine not exceeding five hundred dollars or by imprisonment in jail not exceeding one year.

Section 35 of this same act provides: —

> Every person who kills or causes to be killed, with the consent of the owner or person in possession thereof, any animal under suspicion

that the same is affected with or has been exposed to a contagious disease, and who, upon the inspection of the carcass thereof, finds or is of the opinion that the same is affected with a contagious disease, shall notify such owner or person in possession thereof of the existence of such disease, and shall also immediately notify the Board of Cattle Commissioners of the same, and of the place where the animal was found, the name of the owner or owners or person or persons in possession thereof, and of the disposal made of such carcass. Any person violating the provisions of this section shall be subject to the same penalties as are provided in section fifteen of this act.

In the opinion of the commission, one very potent source of the dissemination of glanders and farcy is in the public drinking troughs and watering tubs.

In Worcester County, for instance, there are a great number of itinerant venders of wares, who buy worn-out and sick horses at nominal prices, a large number of them being purchased outside the limits of this Commonwealth, where they are not subject to strict inspection laws. These animals are lodged in old barns and small buildings during the night, and in the daytime are hitched to the carts from which wares are sold, and driven throughout the surrounding country.

The commission has found cases of glanders in Fitchburg, Clinton, Ashburnham, Westport and Newton Lower Falls, which were directly traceable to the horses of itinerant venders, the disease having undoubtedly been conveyed through the medium of the public watering troughs.

The commission has no practical way of coping with this disease other than by promptly examining all suspected cases, and destroying those that prove to be diseased.

Notwithstanding the fact that many practitioners use and advise the use of mallein as a diagnostic agent in the presence of suspected glanders, this commission has continued to rely upon a carefully made physical examination in all of the cases. It has, however, used mallein to verify these diagnoses in twenty-seven instances; or perhaps the situation would be more accurately stated by saying that in twenty-seven instances of undoubted glanders the mallein was used and its performance carefully watched.

Hog Cholera.

There is but little to say on this subject. Sixty-five outbreaks have been reported during the year. This is a matter which, as a whole, can be very well treated by the owners of animals, and accordingly the Board issued to such owners the following letter of instructions : —

52 Village Street, Boston, Oct. 14, 1895.

Dear Sir : — In treatment of outbreaks of hog cholera, I am instructed by the Board of Cattle Commissioners to direct as follows : Make a thorough separation of the well from the sick animals ; let the well ones be examined frequently, and as fast as new disease is found, put the animal among those that have been set off as sick ; quarantine the whole herd, allowing no animals to be sold from it or none to be added to it until all signs of the disease have disappeared from among them. Place in the food a solution of carbolic acid, — five drops to one hundred pounds live weight of the animal.

Yours truly, F. H. Osgood, *Chairman.*

Rabies.

Strictly speaking, this Board has received no notice of the existence of rabies in the State during the past year, nor have any of its members had any reason to suppose that there had been any outbreak of the sort until on or about the 10th of December, when a statement published in one of the Boston daily papers led to an inquiry and the following correspondence : —

[Copy.]

City Hall, West Newton, Dec. 11, 1895.

Dr. Robert A. Reid, *Newton, Mass.*

Dear Sir : — It appears that by the law of 1894, chapter 491, section 37, "rabies" was made a contagious disease, and the execution of the law in regard to same is with the Board of Cattle Commissioners. Will you be so kind as to write a statement of the case to Dr. Chas. P. Lyman, No. 52 Village Street, Boston, Mass., giving such facts as are in your possession, and the Board of which he is secretary will take immediate action.

Very truly yours,

(Signed) I. F. Kingsbury, *City Clerk.*

[Copy.]

Newton, Mass , Dec. 12, 1895.

Dr. Charles P. Lyman, *Boston, Mass.*

Dear Sir: — The Board of Aldermen of Newton, at special session, ordered all dogs in Wards 1 and 7, east of Laundry Brook, muzzled for four months. Enclosed letter from city clerk explains itself, and why I address you. It is probable that you have seen something of the case in the daily papers, *e. g.*, the "Herald" of Tuesday. Until the 22d ult. the dog, which was but thirteen months old, was just an awkward, good-natured puppy. On the 22d he was very much excited and restless, and showed disposition to snap, and on the 23d bit the seven persons alluded to, including boy on whose bed he had slept each night, and servant girl who fed and petted him. He also fought with every dog he could find, without regard to size. He was taken to the dog and cat home at Brighton, but man in charge gruffly refused to admit him, although the children told him something was wrong with the dog.

He fought with many dogs going to and from that place, wounding some severely. He disappeared at 5 p.m., and was killed at 5 a.m. next morning, at West Roxbury, nine miles distant. What course did he pursue in reaching that place, and how many dogs did he bite? He savagely attacked and bit the man who killed him. Identification was positive a week later, and the autopsy at Boston Veterinary College showed stomach full of stones, sticks, straw, hair and manure. His teeth were all broken. Dr. Ernst has inoculated rabbit, and also one has been inoculated at Pasteur Institute, New York, where children, two of them being my own, are under antirabic treatment.

Since local ordinance was passed, it occurred to me that territory covered is not sufficient, as he visited home of John Campbell on Chapel Street, this city, on the 22d, which is quite a little west of Laundry Brook, but was not admitted, as he was then all dirty and bleeding. Please act promptly and vigorously, as Thursday will be twenty days since the 22d. On October 18 a small black dog, who acted strangely and had run away from home, ran up the street adjoining the home of the dog above mentioned, and ran across a wide lawn and attacked a child. He was beaten off by a coachman, who was bitten. He snapped at several persons, and was killed by the police. Did he bite this dog, and where else did he go, or what other dogs did he bite?

Newton is greatly excited, and will welcome vigorous and far-reaching measures. Dr. Ernst says, even if rabbit does not develop rabies, it will not disprove that dog having rabies, as the dog had been dead and buried for ten days. Owner of dog recalls that about October 18 he came home with nose bleeding from bite.

Yours very truly, (Signed) ROBERT A. REID.

[COPY.]

NEWTON, MASS., Dec. 12, 1895.

A collie dog, owned by Mrs. Alice Kenway of Fairmount Avenue, Newton, Mass., disappeared from home Nov. 23, 1895, after biting some six people and several dogs on that and the preceding day. Said dog was killed in West Roxbury, Nov. 24, 1895, after biting a man there.

The undersigned state that to the best of their knowledge said dog was truly rabid, and wish to call the attention of the Massachusetts Cattle Commission to the same.

(Signed) KENELM WINSLOW.
ROBERT A. REID.

[COPY.]

NEWTON, MASS., Dec. 21, 1895.

DEAR DR. LYMAN: — Dr. Ernst has corroborated our diagnosis of rabies in the case of the Kenway dog, by giving the disease to rabbit. Dr. Ernst reports that the inoculated rabbit died of rabies some days since.

Yours very truly, (Signed) K. WINSLOW.

[COPY.]

BOSTON, MASS., Dec. 23, 1895.

Dr. LYMAN, *Board of Cattle Commissioners.*

DEAR SIR: — I am informed that your Board has jurisdiction over dogs, as well as cattle. On November 23 a rabid dog in Newton, where I live, which has been proved to have been *surely rabid*, bit my son, as well as other children. The dog was killed the next morning in West Roxbury. The city of Newton has ordered dogs muzzled in a part of the city, and it should be also done in Newton Centre as well, as there is strong probability that the dog may have travelled through that section as well as by another route. I have noticed that many of the animals are not muzzled properly, having simply a strap buckled over head and face, which does not prevent them from using their jaws, and have just called the authorities' attention to it.

In my opinion, the fact that a rabid dog roamed the streets for nearly two days makes it a *very serious* matter, as cattle, horses, cats, dogs and other animals may have been bitten. I think that the *most stringent* measures are necessary for the next few months, to protect the community.

Yours truly, (Signed) BRUCE R. WARE.

On December 20 further indirect information was received that a rabid dog had run amuck and been shot at Millbury. The inspector for that town was requested to obtain the carcass of the suspected dog and send it to Village Street. This he did, and immediately upon its receipt the proper steps were begun for the purpose of determining whether or not this animal was actually rabid. The fact cannot be ascertained until after some time from the commencement of the inquiry. Nothing more has been heard concerning this animal.

On December 30 one of the Boston evening papers printed a communication, dated at Watertown on the 30th, stating that a suspected mad dog had been killed in that town, after coming there from Crescent Beach, Revere, where he had bitten a few dogs and several children. In this instance the inspector for Watertown was directed to get possession of the carcass of the suspected dog and send it to the laboratory at once, also to ascertain all that was possible in relation to the animal and his actions.

In answer to this the following correspondence has been received: —

[COPY.]

WALTHAM, MASS., Jan. 2, 1896.

DEAR DR. LYMAN: — I have investigated the mad dog case, as you requested. I found he had been buried in a lot off Howard Street, Watertown. I sent my man down this morning and brought the dog to Waltham, and have shipped him by National express to No. 52 Village Street, at 10.19. I found, on inquiry at the police station, that he had bitten one or more dogs in the town, and ordered them quarantined until the case had been investigated. I asked the chief of police to find out all he could in regard to the case. I enclose copy of letter from the owner of the dog at Revere; will report later if I find anything more pertaining to the case.

Yours truly,
(Signed) W. E. PETERSON, *Veterinary Surgeon.*

[COPY.]

REVERE, MASS.

The Chief of Police, Watertown, Mass.

DEAR SIR: — I was very glad to hear that you had succeeded in shooting my dog. I sincerely hope nothing serious will result from his ravages. I tried to poison him Saturday night, but failed, and on Sunday morning he escaped from the house, so I at once notified the police, and they, with several citizens of Revere, were on the watch for him all day Sunday, but without success. Shall be greatly obliged if you will attach enclosed tag to his collar, and forward by express.

Yours respectfully,

(Signed) T. B. Middlebrooke.

It is well known that generally newspaper reports of mad dog cases are entirely without foundation in fact; that dogs generally killed in the streets are very much more likely to have been suffering from some form of disease other than rabies, or else are the victims of some great mental disturbance. When, however, an actual case of rabies has been discovered, as in the present instance of the Newton dog, all such reports, however vague, coming from even the remote neighborhood of the outbreak, should at once be made the subject of careful inquiry; and, if deemed necessary for the protection of the public health, prompt and decided action on the part of all those whose duty charges them in this direction. This Board is willing to act in this or in any other matter, properly coming to it, with decision and firmness; but it is not ready to undertake measures for the suppression of rabies until it has assured itself, by a knowledge of more than one undeniable case, that that dread disease has really appeared in an epizootic form.

The action of this commission in this direction could be very much more prompt, and so more valuable, if those persons having a knowledge or suspicion of the appearance of this disease would communicate them at once to this Board, and not make it necessary for it to obtain its information as may happen, and at a late day. It does not seem to be at all well understood that rabies was made a contagious disease under chapter 491 of the Acts of 1894, and that under section 29 of that law it is incumbent upon "every person" who has a knowledge or suspicion of the existence of this disease to "immediately give written notice thereof to the board of health of the city or town where such animal or animals are kept."

Dogs that are supposed to be rabid should, if possible, be safely shut up until the fact can be fully ascertained. The commission will at once visit and examine any such animal of which it receives notice. If the animal has already escaped from his home, and must be killed, his body should at once be boxed and sent to the laboratory of the Board at 52 Village Street, that a proper autopsy and pathological examination may be made, which will set aside all doubt in the matter. Secure muzzling of dogs within the infected area is the only possible means of limiting the spread of the disease after it obtains foothold.

As has been said, the greater portion of the work of the commission has been in connection with tuberculosis. For convenience, as heretofore, the report on this work will be divided into several headings, embracing the special classes under which the work was conducted.

Examination of Cattle coming to Brighton, Watertown and Somerville, and Cattle coming from without the State.

Upon Nov. 21, 1894, the Board began the systematic examination, with tuberculin, of all animals, whether coming from within or without the State, arriving at the markets of Brighton, Watertown or Somerville, for sale. This work was continued weekly from that date up to the 30th of April, 1895. Upon page 26 of the report of this Board for the year 1894 will be found a table showing the results of this work up to and including the week of Dec. 26, 1894, embracing the first six weeks of the work at those stations. The further result of this work up to and including the time when the work was discontinued is shown in the following table: —

	Number Examined.	Number Condemned.	Number Tuberculous.	Number not Diseased.	Number Held.
Jan. 8, . .	307	29	26	3	8
Jan. 15, . .	273	23	22	1	11
Jan. 22, . .	194	21	19	2	13
Jan. 29, . .	337	16	16	–	21
Feb. 5, . .	248	14	12	2	8
Feb. 12, . .	294	–	–	–	24
Feb. 19, . .	302	10	4	6	21
Feb. 26, . .	392	16	16	–	22
March 5, . .	447	11	9	2	10
March 12, . .	353	–	–	–	18
March 19, . .	344	20	16	4	12
March 26, . .	371	16	13	3	33
April 2, . .	395	5	4	1	22
April 9, . .	404	7	5	2	19
April 16, . .	302	6	–	–	11
April 23, . .	142	1	–	–	7
April 30, . .	744	18	–	–	21

During the weeks beginning February 12, March 12, April 16, 23 and 30, no animals were killed. In the last three weeks no animals were killed because of failure of appropriation.

An examination of the above table shows that during this period 5,849 animals were examined. Of the 213 which were condemned, only 188 were killed prior to April 30. Of these, 162 clearly demonstrated the presence of the disease and 26 were found free from disease. The 18 which were condemned and the 21 which were held for retest on April 30 were all held in quarantine until June 5, at which time 3 had died. Of the remaining 36, 30 were found diseased on post-mortem examination and 6 were released. As will be seen also, the average number of animals examined in each week was 344.

The results of the work, as the table shows, varied greatly from week to week; in some weeks practically no condemned animals were killed in which the disease was not plainly demonstrated by the post-mortem examination; at other times, as on February 19, a large proportion of those condemned and killed were pronounced by the post-mortem examination to be free from tuberculosis.

As stated in our previous report, under the system established by the commission at these markets, animals where tuberculosis was not detected with tuberculin were branded before being freed from quarantine. After the animals were so branded they passed out of the control of the Board, and the commission had no means of following them, to determine whether or not they subsequently showed any evidence of tuberculosis, and, if so, whether the presence of such disease, afterwards found, indicated that the animals were affected at the time when the brand was affixed. The commission has had within its observation very few instances of such animals being found affected with tuberculosis upon subsequent slaughter.

The slaughter houses at Brighton are under the supervision and control of the health department of the city of Boston, and on page 114 of the report of that department for the year 1894 (City Document, No. 13) will be found the following: —

> The following table shows the number of animals killed, which failed to react to the tuberculin test, and had been pronounced free from tuberculosis, the Commonwealth brand having been placed upon the right hip: —

ANIMALS.	Number Killed.	Number Tuberculous.	Percentage Tuberculous.
Cows, ...	62	4	–
Steers, ...	1	–	–
Total, ...	63	4	6.34

In regard to this work, it should be remembered that the undertaking was experimental, for the purpose of determining whether the tuberculin test could be successfully applied to animals coming to these markets, under the conditions which existed there, without serious inconvenience to the dealers, in a way that would assure purchasers that the cattle there dealt in were free from tuberculosis; and this commission stated, in its report for the year 1894, on page 23, that: —

> With the adoption of the tuberculin test, the Board determined to inaugurate, if possible, some practical method whereby all the cattle

coming to these markets should be subjected to the tuberculin test before being offered for sale. Whether or not, in view of the circumstances under which these animals have to be examined, such a result can be obtained by the tuberculin test, still remains to be proved.

This experiment was continued under substantially the same conditions until April 30, 1895.

The commission, after a most extended work with tuberculin, is satisfied that the unsatisfactory results which were obtained at these markets were not due to the inability of the agent tuberculin to disclose the presence of the disease when applied under proper conditions, but were due to other causes, of which the commission has made a most careful study. Upon pages 22 and 26 of our report for last year will be found the views of the commission as to the difficulty of making successful tests at these markets, and the reasons for it.

In continuing this work, the commission made every reasonable endeavor to reduce to a minimum, or eliminate, the unfavorable conditions under which the work was obliged to be conducted, while at the same time endeavoring not to interfere any more than was absolutely necessary with the interests of those selling and buying cattle at these markets.

Long familiarity with the work of testing cattle with tuberculin has convinced the commission that it is an extremely delicate test, and that satisfactory results cannot be uniformly obtained unless the animals to be tested are in substantially a normal condition; which means that they must be free from local causes of excitement, must be in surroundings which are reasonably familiar to them, must have been regularly fed and watered prior to the time of the test, and that immediately prior thereto they should not have been subjected to any unusual circumstances of any kind, such, for instance, as those inseparably attending a railroad journey.

Inasmuch as the work which was conducted at Brighton was entirely novel, and the commission was not able at that time to gather from the experience of others to what extent the abnormal conditions and strange surroundings would interfere with the proper application of the tuberculin test, it was but natural that these conditions were not fully appreciated in the early stages of the work.

Long custom at these markets had established the practice of having the regular market day for the sale of animals upon Wednesday in each week. In order that the dealers might have their animals at Brighton ready for the market on Wednesday, their regular transportation companies had arranged for trains to bring cattle to these markets so that they should be delivered on Monday night and Tuesday morning of each week. The animals were then allowed a day of rest before being offered in the market, during which time they were given ample feed and water, and whatever attention the owners considered necessary, in order that they might be in as good a condition as possible on the day of sale.

In order to make a proper examination with tuberculin, it is necessary to submit the animal to the test for a period of at least twenty-four hours, not including the time necessary for taking proper preliminary temperature observations, in order to determine with reasonable accuracy the normal temperature of the animal before injecting the tuberculin.

It will be remembered that the conditions which confronted the commission when this work was inaugurated were that the animals, in the great proportion of cases, did not arrive at the market much more than twenty-four hours before they were offered for sale. In order, therefore, that these animals might be tested before being offered in the market, if the market day was kept the same as heretofore and the animals were delivered at the same time, it was necessary to begin the test immediately upon their arrival, and therefore no time was given to quiet the animals before applying the test, or to feed and prepare them for sale in the market after the test was completed.

The first step undertaken, therefore, by the commission, as being the one that would produce the least inconvenience to the dealers, and which they hoped would be accompanied by favorable results, was to change the market day from Wednesday to Thursday in each week. Under this arrangement the tests were begun upon Tuesday night and were not completed until late in the afternoon of Wednesday, at which time the animals which had shown no reaction to the tuberculin were delivered over to the owners. This arrangement was unsatisfactory to the dealers, because it gave them but little more than twelve hours in which to prepare the animals for market, whereas before they had had more than double that time in many instances. On the other hand, the animals were subjected to the test within practically twenty-four hours, and frequently within less, of their arrival in the market.

Under these conditions this work was carried on until April 30 of this year, when the commission came to the conclusion that it would be impossible to produce satisfactory results with tuberculin unless animals could be allowed a much longer time in which to settle into a sufficiently normal condition before being subjected to the examination.

In this connection it should be remembered that, while this work at Brighton and Watertown was being conducted under these peculiar conditions, the commission was at the same time successfully conducting large numbers of tests throughout the State, in systematic work and in examination of animals reported as suspicious; and it thus had an opportunity of comparing the results of these two classes of work, in which the same diagnostic agent was used, prepared in the same way and derived from the same source; and the commission became convinced that the unsatisfactory results at Brighton were due to the conditions under which the tests were necessarily made, and not to the unreliability of the diagnostic agent.

As bearing upon this, the commission desires to quote the following statement from the eighteenth annual report of the Pennsylvania State Board of Agriculture for the year 1894, official document No. 7, at page 106, published during the present year: —

> The experience of the officers of the Board in the administration of this test to more than one thousand animals appears to clearly prove the following points: —
>
> 1. That, in proper and capable hands, tuberculin is a safe and sure diagnostic agent for tuberculosis, and that in all the cases coming under our notice not a single error has been shown, although all cases of condemnation by this agent have been followed by careful post-mortems.
>
> 2. That great care is absolutely necessary in obtaining the normal temperatures of the animals. We usually start out with the intention of condemning all which indicate a rise of two and one-half degrees or more; and, inasmuch as the normal temperature varies somewhat with the time of day, the season and the time of feeding, some ani-

mals showing a considerable elevation of temperature at the time of feeding, but failing to show any further elevation under the action of the tuberculin, it is therefore very important to obtain the average normal temperature without its being influenced by surrounding circumstances. . . .

9. That exposure to the hot sun, long-continued confinement in an illy ventilated building, unusual changes of food, especially from green to dry feed, failure to water at usual time, and in some nervous animals any exciting cause, may produce more or less variation from the normal temperature. . . .

16. The causes which may produce a rise in temperature without the injection of tuberculin may be enumerated as follows: —

Near approach of calving, which, with some animals, will give a rise of temperature which may mislead. Variations in feed, especially from green grass to dry feed, without sufficient water; errors in this direction have been brought up off green pasture and confined in a barn, on dry food, while the test was in progress. With nervous animals, the excitement due to the presence of strangers and the attending surroundings may cause an elevation of temperature, which, however, from its low rate, should not mislead a careful observer. In fact, any sudden variation in the treatment of the herd may cause a rise in temperature, and, if this is not taken into account, it may at least partially mislead.

Almost every one of these peculiar conditions referred to in this report are met with in the experience of the commission at Brighton.

A further remark might be made in this connection, in regard to the discrepancy between the results as found on post-mortem examination and those indicated by the tuberculin test, admitting the tuberculin to have been applied under proper normal conditions. The post-mortems which are made at Brighton, Watertown and Somerville are necessarily conducted in the ordinary way that field examinations are made, where a large number of animals have to be handled, and where necessarily the examiner does not have laboratory facilities. In such examinations it is customary for the examiner to look for the disease in those organs and portions of the body where experience has shown that it is most apt to be found, and, if the disease is not there found, the examination is not further pursued, because needed additional facilities are not at hand.

In the experience of this commission and others, frequent cases have arisen where the disease has been found in portions of the body not ordinarily examined in the regular post-mortem examination, and in such cases the animal upon the ordinary examination would be pronounced free from disease.

As an instance of this sort, the commission would cite the following case in its experience: an animal was condemned and killed, and a most careful and thorough examination of the more usual locations was made to discover the seat of the trouble. Evidence of the disease not being found, it was then noticed that one of the hind legs was somewhat swollen. The skin was stripped down, and along the chain of lymphatics lying between the tendon and the bone numerous deposits of undoubted tuberculous material, quite patent to the naked eye, were discovered. It is fair to say, further, that this product was taken to the laboratory and examined, and proved to contain large numbers of the bacilli.

A further and very interesting instance in the experience of members of this Board is one wherein, after the more usual examinations had been made and no disease discovered, attention was called to one of the eyes, where, at the inner canthus, an undoubted mass of the tuberculous deposit was found. The diagnosis was proved in the laboratory.

It has occurred further, in the experience of the members of the Board, in their practice as veterinarians, when their attention has been called to a live animal exhibiting disease of either the brain or spinal cord, that, after death, deposits of the peculiar product of tuberculosis have been found within one or the other or both of these organs. It is not usual, in the ordinary post-mortem examinations, to open the cavities containing the brain and spinal cord, because of the great time required and the carefulness of the manipulation necessary; nor is it customary to examine the eyes or the legs, below the larger joints, for the presence of the disease; and yet, had not these examinations been made in these instances, the animals would have been pronounced free from disease, and the error would have been laid to tuberculin.

It is examples of this sort which make the commission, after its long experience, feel that, when tuberculin is applied under proper conditions and clearly points to the presence of the disease, and post-mortem examination fails to find such disease, it is unsafe to charge the error to tuberculin.

In this connection the Board would call attention to the following extract from a paper read by Dr. W. B. Niles of the veterinary department of Iowa State College before the Des Moines meeting of the United States Veterinary Medical Association. He says: —

> When a characteristic reaction occurs, that is, where there is a marked rise above the normal, continuing for several hours, I believe in every case the animal has tuberculosis, whether the post-mortem examination shows the lesions or not; that is, I would place a greater reliance upon the tuberculin test than I would on the post-mortem examination. We all know that the lesions may be easily overlooked, or microscopic, and thus escape detection.

Upon June 5, 1895, a law was passed by your honorable body, being chapter 496 of the Acts of the year 1895, section 14 of which law is as follows: —

> Until June first, eighteen hundred and ninety-six, the use of tuberculin as a diagnostic agent for the detection of the disease known as tuberculosis in domestic animals shall be restricted to cattle brought into the Commonwealth from any point without its limits and to all cattle held in quarantine at Brighton, Watertown and Somerville; *provided, however*, that tuberculin may be used as such diagnostic agent on any animal or animals in any other portion of the State upon the consent in writing of the owner or person in possession thereof, and upon any animals condemned as tuberculous upon physical examination by a competent veterinarian.

After the abandonment of examinations at Brighton, Watertown and Somerville, on April 30, the commission watched, as far as it could, the effect upon the market of the withdrawal of quarantine regulations and the consequent throwing open of the market to the free and unrestricted sale of cattle of all kinds. From April 30 to the first day of July, at which time the new regulations came into force, the general character of the animals offered for sale at these markets was distinctly inferior to those which had been offered for sale there under quarantine regulations heretofore maintained by the Board.

The commission also, during this period, had numerous requests from cattle dealers and buyers trading at these markets, urging it to resume its work at these stations, as being of great value to them in determining the soundness of animals there offered for sale. So many applications of this sort were received that the commission deemed it advisable to meet the parties most largely interested for the purpose of discussing ways and means for producing the best results with the least inconvenience to the dealers; and accordingly, on June 8, 1895, the following circular letter was issued, and a copy of it sent to all the interested parties, so far as their addresses were known to the Board: —

52 Village Street, Boston, June 8, 1895.

Dear Sir: — The commission will be very glad to meet those interested in the transportation and sale of cattle within the borders of this Commonwealth at the Quincy House, Boston, on the afternoon of Tuesday, June 11, 1895, at 3 p.m., to consider how the work of the commission can be carried on in the best interests of the State, with the least possible inconvenience to those concerned.

Yours truly,
(Signed) F. H. Osgood, *Chairman.*

At the meeting which followed, representatives of nearly all of the dealers in cattle coming from without the State were present, as well as of some of those interested in Massachusetts cattle only; to all of whom the following statement was made: —

Inasmuch as chapter 491 of the Acts of 1894, as amended by chapter 496 of the Acts of 1895, provides that animals coming from without the borders of the Commonwealth shall be subjected to the tuberculin test prior to being distributed throughout the State, and the commission has taken the stand that it is impracticable to examine animals recently shipped until they have had time thereafter to settle into their normal condition, which, in the opinion of this commission, cannot safely be set at less than six days, it is for the interest of drovers to have the animals which they propose to ship examined before leaving the State from which they are to come, in order that they may be placed upon the market immediately after arrival.

This proposition, although giving rise to a considerable discussion, was finally adopted by the dealers as being fairly satisfactory to them, with the additional option, also suggested by the commission, that, when it is inexpedient to have the animals tested prior to leaving the State from which they are to be shipped, they will be received at either of the three markets and there placed in quarantine for a period of not less than six days, at the expense of the owner. At the expiration of that time, if the animals are in a normal condition, they will be tested by this commission without expense to the owner, those found free from tuberculosis will be released, and those which prove to be tuberculous will be condemned and destroyed without compensation.

In arriving at the conclusions upon which subsequent action in this matter was based, the Board was governed largely by the following considerations: in the law which was enacted by your honorable body, the commission felt that it was your desire that animals located within the limits of this Commonwealth should not be further submitted to a compulsory tuberculin test; and the first step taken by the commission, therefore, was to eliminate from quarantine restrictions imposed at these yards all animals arriving there from points within the limits of the Commonwealth. Inasmuch as the commission felt that it was not authorized to require a compulsory examination of all these animals, it did not feel that it was wise or expedient to inaugurate at these markets a system of voluntary tests, because, as had already been shown to the satisfaction of this Board, such tests could not be satisfactorily made unless the animals were first placed under a fairly normal condition. It was further felt that but little good would be derived by the community from the making of isolated tests at these markets upon requests, even though the conditions could be made normal; because it would not insure that all animals at this market were so tested; and because the commission felt that, in view of the amount of the appropriation at its command, the expense in the way of payment of compensation would be too great, for the reason that there would be a tendency on the part of certain persons throughout the State, who had neat stock suspected of being tuberculous, to deliver them at these markets for sale, with the request for a tuberculin test, and in this way large sums would be paid in compensation, without any commensurate gain to the community, in stamping out the disease, even locally; and, finally, that, inasmuch as the commission had not the power to compel the owners of such cattle to submit their animals to a tuberculin test before arriving at the markets, as was to be done in the case of animals coming from without the State, the expense of continuing examinations at these markets would be too great to warrant the maintenance of such a system for Massachusetts cattle alone.

The problem of properly dealing with cattle coming from without the State had been an extremely difficult one. As a result of the system of examinations theretofore conducted by the commission, it was felt that further systematic examinations of all animals brought to this market from without the State could not be successfully carried on unless ample opportunity was given for the animal to become accustomed to its new surroundings, so that such animal might be in substantially normal condition; and experience had taught the commission that this would require a period of not less than six full days. Inasmuch as the animals were brought to this market on Monday and Tuesday of each week, this meant that they must remain in quarantine over the following market day, and certainly as long as possible before the next succeeding market day; that is, the test could not be properly made before Monday of the following week; but, even under these circumstances, inasmuch as the test would require a period of substantially twenty-four hours, no reasonable opportunity could be given to the owner to prepare the animal for market, after the completion of the test, before the following market day, on Wednesday.

The commission felt, further, that, if this requirement should be insisted upon, it would not only be attended with serious inconvenience and loss to the owners, but also by a considerable expense for extra keep and care, which either the owners or the Commonwealth would have to pay, and which seemed unwarrantable if other possible and less expensive means could be devised.

On the other hand, as a result of the whole work up to this time, the Board felt more strongly than ever that there was no practical means of assuring purchasers that animals were free from tuberculosis except by subjecting such animals to a tuberculin test, and that such test must be applied under normal or farm conditions. As a result of all this, it was felt that, if any means could be devised whereby animals could be subjected to the tuberculin test before being shipped to market, it would be a distinct advantage to all parties concerned; that the test would be more apt to be applied under favorable circumstances, and consequently the purchaser would be more certain of the result; that the expense to the owner would be far less, although borne by him, than would be the case were he obliged to maintain a week's quarantine at these markets, while at the same time the saving to the Commonwealth would be very great; and, further, if any animals were found to be diseased, they could be destroyed in the State of their residence, where the owner could receive the compensation provided by the laws of such State, whereas, if brought here and destroyed, he received no compensation.

The commission, having arrived at the conclusion that it was advisable, as far as practicable, to arrange for the admission of cattle coming to these markets after they had been subjected to the tuberculin test in the State from which they were shipped, felt that, at the same time, the permission to bring cattle from without the limits of the Commonwealth to any other points in the State should also be embraced in the same regulation. Prior to the adoption of this rule, it will be remembered that cattle coming to any point within the State other than Brighton, Watertown and Somerville were subjected to the regulations of General Order No. 3, section 10, issued Nov. 20, 1894, as follows: —

> After crossing the border, all such cattle are hereby declared quarantined upon premises which shall be defined in the permit, within the limits of such city or town, at the expense of the owner or consignee, and shall there remain until they have been examined and released or condemned by this Board or one of its members. No neat cattle shall be driven within this State from any point without its limits except as herein provided.

Under this system the animal was held in quarantine until such time as the agent of the Board could be sent to the locality and subject it to the tuberculin test. From Dec. 15, 1894, to July 8, 1895, 124 permits of this kind were issued for 1,197 animals. Of these, 306 were examined with tuberculin, 8 were condemned and found diseased upon post-mortem examination, and the balance were discharged from quarantine without examination, because of the absence of funds for continuing the work; although no compensation was paid for any of these animals that might prove to be tuberculous, as they had not been within the State six months prior to being destroyed.

Under this system the tuberculin test proved to be reliable, although the animals had come from substantially the same localities as those in the markets of Brighton, Watertown and Somerville; and the tests were made with the same tuberculin, derived from the same source, applied in the same manner and by the same persons, again demonstrating the importance of the question of environment.

While the scientific results were reasonably satisfactory, this system was found to be unsatisfactory because of its very considerable cost. These animals came to points widely scattered throughout the Commonwealth, requiring the attendance of an agent for an isolated examination; and in such cases the State was obliged to bear the travelling expenses to and from the point, and at the same time the expense of the entire time of the agent was chargeable in most cases to the examination of but few animals.

With the adoption of the system of examinations without the limits of the Commonwealth, as applied to the cattle coming to Brighton, Watertown and Somerville, it was decided to apply the same general rule to animals coming in at other points.

Upon July 8, 1895, the commission issued General Order No. 9, covering the entire matter of cattle coming into the Commonwealth from without its limits, a copy of which, together with an explanatory letter, is as follows: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
52 VILLAGE STREET, BOSTON, July 8, 1895.

To All Persons whom it may concern.

We, the Board of Cattle Commissioners for the Commonwealth of Massachusetts, by virtue of the power and authority in us vested by law, and especially under the provisions of chapter 491 of the Acts of the year 1894 and chapter 496 of the Acts of the year 1895, have adopted and do hereby issue the following order, for the purpose of preventing the introduction of tuberculosis and other contagious diseases within the limits of the Commonwealth of Massachusetts, and also for that purpose to establish reasonable quarantine regulations covering the importation of cattle from without its limits: —

General Order No. 9.

First. — General Order No. 3, dated Nov. 20, 1894, is hereby repealed.

Second. — All the States and Territories of the United States, other than the Commonwealth of Massachusetts, the District of Columbia, Canada, Great Britain and all other localities without the limits of this Commonwealth, are hereby declared to be infected districts.

Third. — All neat cattle brought within the limits of this Commonwealth from any of said localities on and after July 9, 1895, are hereby made subject to the quarantine regulations herein set forth. Except as provided in paragraph 9 of this order, no such cattle shall be brought within the limits of this Commonwealth, nor shall they be unloaded from any car or vehicle upon or within which they have been transported, except in case of accident, for any purpose whatsoever, except upon a written permit therefor duly issued by the Board of Cattle Commissioners or one of its members.

Fourth. — Every person or corporation desiring to drive, bring or transport, or to cause to be driven, brought or transported into this Commonwealth, from any of the localities designated in paragraph 2 of this order, any neat cattle, shall notify the Board of Cattle Commissioners in writing of his or its intention so to do, which notice shall state the name and residence of the true owner and consignee, the city or town within this Commonwealth through which it is the intention to enter, or, if said animals are to be transported, then of the city or town at which it is the intention that such animals shall be unloaded, the location of the premises within the limits of such city or town where said animals are to be delivered or kept, the name of the true owner or person in possession of the same, the name of the railroad company by which such cattle are to be shipped, and the time when it is the intention that the animals shall arrive within such city or town. Every such application shall be accompanied by a certificate, executed in duplicate, based on a tuberculin test, that, in the opinion of the veterinarian signing the same, each such animal is free from tuberculosis. Each such certificate shall give a description of the animal sufficiently accurate for easy identification, as well as a brief statement of the condition of such animal found upon a physical examination. It shall also state the preparation of tuberculin used, the quantity injected, the temperature ascertained immediately previous to inoculation, and also the temperature at the eleventh hour and every two hours subsequent thereto for a period of at least ten hours, or until the reaction has been completed. The certificate shall be signed by a veterinarian whose competency shall be certified to by the Board of Cattle Commissioners of the State from which said animals are driven or shipped, or of such other board or authority as may have jurisdiction over the matter of the suppression of contagious diseases among domestic animals in such State or country. Forms of such certificates will be furnished by this Board upon application.

Fifth. — If such certificate is satisfactory to this Board, one of said certificates will be retained by this office and the duplicate certificate will be returned to the owner, together with a permit to such applicant to enter and deliver such animal in the manner and at the time and place designated in such application.

In case of every such permit the duplicate certificate of soundness and the permit of entry shall accompany the bill of lading of such animal, or, if such animal is driven in on the hoof, then shall be sent with said animal. Upon the arrival of every such animal at the place designated in the permit such animal shall be and hereby is declared to be quarantined upon the premises of the owner or consignee, and at his expense, and shall there remain until such animal has been examined by some agent of this Board thereto duly authorized, or the inspector designated in the permit.

Upon the arrival of such animal, the owner shall immediately notify this office or such inspector or agent as shall be designated in the permit, and shall deliver to such person so notified, or to some agent of this Board thereto duly authorized, the certificate of soundness and permit accompanying such animal. Such animal will be released by such agent or inspector upon being identified as corresponding with the description contained in such certificate, and in such case the person so releasing the animal will detach the duplicate certificate of soundness and return the same to such consignee or owner, and will return the permit to enter, with his endorsement of release, to this office.

If such animal should not correspond, in the opinion of such agent or inspector, with such certificate, such animal will be continued in quarantine and treated as provided in paragraph 7 of this order.

Sixth. — Whenever application is made, as provided in paragraph 4 of this order, to drive, bring or transport, or cause to be driven, brought or transported, neat cattle within the limits of this Commonwealth from any of the localities designated in paragraph 2 of this order, without said application being accompanied with a certificate satisfactory to this Board, as therein provided, a permit will be issued by this Board or a member thereof to enter and deliver such animals in the manner and at the time and place designated in such permit, which permit will state that such animals are not accompanied with a certificate of soundness. Such permit shall accompany the bill of lading of every such animal, or, if the animal is driven in on the hoof, then shall be sent with such animal; and upon the arrival of the animals at the place designated in said permit notice shall be sent, and said permit shall be delivered in the same manner as is provided in paragraph 5 of this order.

Every such animal, if brought within the limits of the Commonwealth by any of the regular lines of steam-rail transportation, as soon as it has arrived at the place designated in said permit, and every such animal brought in on the hoof or otherwise, upon its arrival at the city or town of entry within the limits of this Commonwealth designated in said permit, shall be and is hereby declared to be quarantined upon the premises of the owner, consignee or person in possession thereof, at the expense of such owner, consignee or person in possession, until such animal shall have been subjected to the tuberculin test, and is condemned or freed, as provided in paragraph 7 of this order.

Such test will not be applied until such animals have been under quarantine restrictions and regulations for a period of at least six days.

Seventh. — Every animal which, in the opinion of this Board or any of its members, after being subjected to a physical examination and to the tuberculin test, is affected with tuberculosis, will be condemned and killed as provided in section 53 of chapter 491 of the Acts of the year 1894. If, in the opinion of this Board or one of its members, after such examinations, such animal is free from tuberculosis, the same will be discharged from quarantine.

Eighth. — Wherever a permit is issued to bring any animal within the limits of this Commonwealth, as herein provided, upon the hoof or in any other manner than upon any of the regular lines of steam-rail transportation, such animal shall not enter this State at any other city or town than the one designated in such permit; and wherever a permit is issued to enter any such animal by any of the regular lines of steam-rail transportation, such animal shall not be unloaded, except in case of accident, within the limits of any other city or town within the limits of this Commonwealth than the one designated in this permit, except after it has been regularly released as herein provided; and any person violating the provisions of this paragraph will be punished as provided in section 47 of chapter 491 of the Acts of the year 1894.

Ninth. — Any person may bring or transport or cause to be brought or transported any neat cattle from any point without the limits of this Commonwealth designated in paragraph 2 hereof, to be delivered by any regular lines of steam-rail transportation directly to the Union Stock Yards at the town of Watertown, the Boston & Albany Stock Yards at Brighton, within the city of Boston, and the premises of the New England Dressed Meat and Wool Company at the city of Somerville, without first obtaining from the Board of Cattle Commissioners or a member thereof a written permit so to do; but such animal shall not be unloaded, after arriving within the limits of this Commonwealth, at any other place, except in case of accident, and in such case as soon thereafter as practicable shall be immediately shipped to one of the places designated in this paragraph. Animals so transported upon being unloaded are hereby declared quarantined. Animals unloaded at Brighton must be unloaded within the Boston & Albany Stock Yards, and are hereby declared quarantined therein upon the premises of the owner, consignee or person in possession. Animals unloaded at Watertown must be unloaded within the Union Stock Yards, and are hereby declared quarantined therein upon the premises of the owner, consignee or person in possession. Animals unloaded at Somerville must be unloaded upon the premises of the New England Dressed Meat and Wool Company, and are hereby declared quarantined therein upon the premises of the owner, consignee or person in possession. Such quarantine, so long as the same continues, shall be at the expense of the owner, consignee or person in possession.

Tenth. — Every such animal shall be accompanied with duplicate certificates that such animal is, in the opinion of the veterinarian signing the same, free from tuberculosis. Such certificates shall in all respects as to the form, contents and execution, correspond with the certificate required by paragraph 4 of this order, and shall further contain a statement signed by the person shipping said animal, setting forth the name in full and residence of the true owner of the same and of the consignee thereof. Blank forms of such certificates will be furnished by this Board upon application. Upon the arrival of all such neat stock, the owner, consignee or person in possession shall immediately deliver to the Board of Cattle Commissioners or one of its members or to some agent thereof thereto duly authorized the duplicate certificates above provided for, which shall not be separated by such owner, consignee or person in possession, and shall point out the animal to which such certificate is claimed to belong. If such animal shall be found to correspond with the description contained in such certificate, and if said certificate is satisfactory to this Board or such commissioner, said animal will be immediately released from quarantine, and the duplicate certificate will be returned to such owner, consignee or person in possession.

Eleventh. — All neat cattle brought from any point without the limits of the Commonwealth, designated in paragraph 2 of this order, delivered at any of the premises designated in paragraph 9 hereof, not accompanied with a certificate of soundness provided for in paragraph 10 hereof, satisfactory to the commission or a member thereof, will be continued in quarantine upon the premises of the owner, consignee or person in possession thereof within the limits of said premises, and at the expense of such owner, consignee or person in possession, until such animal has been subjected to the tuberculin test, and has been killed or freed, as provided in paragraph 7 hereof. Such test will be applied upon Monday of each week, but no such animal shall be tested until after the same has remained under quarantine restrictions and regulations for a period of at least six days.

Twelfth. — All neat cattle brought within this Commonwealth consigned directly to the Brighton Abattoir for slaughter shall be confined by themselves for identification, and shall not be released except as herein provided in paragraph 7, or for immediate slaughter.

Thirteenth. — No person shall slaughter or offer or expose for sale (or have in his possession, except under quarantine) within the stock yards at Brighton and Watertown, or within the premises of the New England Dressed Beef and Wool Company at Somerville, any neat cattle brought within the limits of this Commonwealth after the passage of this order, from any point designated in paragraph 2 hereof, which have not been released from quarantine by the Board of Cattle Commissioners or one of its members, or an agent thereto duly authorized, as provided in paragraphs 5, 7, 10 and 12 hereof.

Fourteenth. — All neat cattle brought within the limits of this Commonwealth from any point without, mentioned in paragraph 2 hereof, except upon written permit of the Board of Cattle Commissioners or some member thereof or as provided in paragraph 9 hereof, are hereby declared quarantined.

Fifteenth. — No person shall drive, bring or transport, or cause to be driven, brought or transported within the limits of this Commonwealth, from any point mentioned in paragraph 2 hereof, any neat cattle except as herein provided; and all cattle brought into the limits of this Commonwealth contrary to this order and regulation will be quarantined at the expense of the owner, consignee or person in possession, wherever they can be found; and such animal shall remain in quarantine as long as the public safety, in the judgment of this commission, requires; and any person violating this regulation and order, or entering cattle within the limits of this Commonwealth contrary to the provisions hereof, will be prosecuted for every such offence.

Sixteenth. — It is further ordered that three copies of this order shall be sent to each city and town throughout the Commonwealth, and that each city and town shall cause a copy thereof to be posted in two or more conspicuous places within its limits, or shall cause a copy of the same to be published once a week for three successive weeks, in some newspaper published within its limits.

Seventeenth. — This order shall take effect upon the ninth day of July, 1895.

FREDERICK H. OSGOOD, *Chairman*,
CHARLES P. LYMAN, *Secretary*,
MAURICE O'CONNELL,
LEANDER F. HERRICK,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

In the case of animals coming to the regular markets of Brighton, Watertown and Somerville, the Board required that each animal should be accompanied by a duplicate certificate in the following form: —

CERTIFICATE OF TUBERCULIN EXAMINATION OF NEAT CATTLE REQUIRED UNDER GENERAL ORDER NO. 9.

(*To accompany neat cattle brought directly to the stock yards at Brighton, Watertown or Somerville, from without the limits of the Commonwealth.*)

To Massachusetts Board of Cattle Commissioners, 52 Village Street, Boston.

Original.

(*To be retained by the Cattle Commissioners.*)

State of 189

City or town of

Owner,

Description of animal,

Physical condition,

Preparation of tuberculin,

Quantity injected,

Date, Normal temperature at P.M.

1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
12 M.
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
12 M.

In my opinion, the above-described animal is free from tuberculosis.

Veterinary Surgeon.

City or town of

State of 189

I, shipper of the above animal, hereby certify that the true owner and consignee of said animal are: —

Owner (name in full),

Residence,

Consignee (name in full),

Residence, *Shipper.*

Address,

The above certificate is satisfactory to me, and I identified and released said animal at the stock yards at on the day of 189

Commissioner.

CERTIFICATE OF TUBERCULIN EXAMINATION OF NEAT CATTLE REQUIRED UNDER GENERAL ORDER NO. 9.

(To accompany neat cattle brought directly to the stock yards at Brighton, Watertown or Somerville, from without the limits of the Commonwealth.)

To Massachusetts Board of Cattle Commissioners, 52 Village Street, Boston.

Duplicate.

(To be returned to owner or consignee.)

This certificate must not be detached from the original except by a Massachusetts Cattle Commissioner.

State of 189

City or town of

Owner,

Description of animal,

Physical condition,

Preparation of tuberculin,

Quality injected,

Date, Normal temperature at P.M.

1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
12 M.
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
12 M.

In my opinion, the above-described animal is free from tuberculosis.

Veterinary Surgeon.

Identified and released by me at the stock yards at on the day of 189 .

Commissioner.

Upon the arrival of the animals at any of the above-designated markets, a member of the commission or an agent of the Board is present for each market day, to examine and identify the animals arriving. This commissioner or agent not only identifies the animal as corresponding with the certificate, but in each case makes a careful examination of the tuberculin test, as shown upon the face of the accompanying record, to see whether the temperature readings indicate that the animal is free from disease. If all is found to be satisfactory, the certificate is approved, the animal released, and the duplicate certificate detached and sent to the owner, the original being filed with the records of the commission. This method has been pursued since that date, with substantially no variations excepting that the Board has endeavored to render the identification of the animals more certain, to which end the following order was issued: —

Notice to Drovers.

We call your attention to the following requirements on cattle shipped from without the State to the quarantine stations at Brighton, Watertown or Somerville: —

First. — The animals must be properly tagged in the ear, or otherwise, so that they may be readily identified by numbers corresponding with the number on the accompanying certificate of tuberculin test; and the certificate must contain a description of the animal sufficient for identification.

Second. — This test must be made by an approved veterinarian, who is vouched for by the Cattle Commission of the State from which the animals were shipped; must state the quantity and preparation of tuberculin used; and the temperature must be registered from the tenth hour after the injection every two hours until the twentieth. Satisfactory test is impossible when the initial temperature is higher than $102\frac{3}{5}$.

Unless the above rules are observed, the animals will be held the usual six days and retested.

(Signed) Board of Cattle Commissioners.

When it is desired to ship animals into Massachusetts to be unloaded at points other than Brighton, Watertown or Somerville, another form of permit is issued. If such animals are to be tested before entering the State, the certificate is in the following form, and is first properly filled by the veterinarian making the test; it is then forwarded to the office of this commission for examination and approval. If all is satisfactory, permission is at once sent to the agent of the transportation company where the animals are to be unloaded. The certificates are at once sent to the local inspector of the same city or town, who then examines the cattle for identification, and, if this is satisfactory, releases them to the owner or consignee.

Certificate of Tuberculin Examination of Neat Cattle required under General Order No. 9.

(To accompany application for entry into Massachusetts.)

To Massachusetts Board of Cattle Commissioners, 52 Village Street, Boston.

Original.

(To be retained by the Cattle Commissioners.)

State of 189

City or town of Owner,

Description of animal, Physical condition,

Preparation of tuberculin, Quantity injected,

Date Normal temperature at P.M.

1 A.M.	7 A.M.	1 P.M.	7 P.M.
2 A.M.	8 A.M.	2 P.M.	8 P.M.
3 A.M.	9 A.M.	3 P.M.	9 P.M.
4 A.M.	10 A.M.	4 P.M.	10 P.M.
5 A.M.	11 A.M.	5 P.M.	11 P.M.
6 A.M.	12 M.	6 P.M.	12 M.

In my opinion, the above-described animal is free from tuberculosis.

Veterinary Surgeon.

Certificate of Tuberculin Examination of Neat Cattle required under General Order No. 9.

(To accompany application for entry into Massachusetts.)

To Massachusetts Board of Cattle Commissioners, 52 Village Street, Boston.

Duplicate.

(To be returned to owner.)

This certificate must not be detached from the permit, and must accompany the bill of lading or animal.

State of 189

City or town of Owner,

Description of animal, Physical condition,

Preparation of tuberculin, Quantity injected,

Date Normal temperature at P.M.

1 A.M.	7 A.M.	1 P.M.	7 P.M.
2 A.M.	8 A.M.	2 P.M.	8 P.M.
3 A.M.	9 A.M.	3 P.M.	9 P.M.
4 A.M.	10 A.M.	4 P.M.	10 P.M.
5 A.M.	11 A.M.	5 P.M.	11 P.M.
6 A.M.	12 M.	6 P.M.	12 M.

In my opinion, the above-described animal is free from tuberculosis.

Veterinary Surgeon.

Identified and released by me at the city or town of 189

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
52 VILLAGE STREET, BOSTON, 189 .

PERMIT TO BRING NEAT CATTLE INTO MASSACHUSETTS.

(To be detached only by the person discharging said animal from quarantine, and when so detached to be forwarded immediately to this office.)

To

City or town of State of

You are hereby authorized to bring within the limits of the Commonwealth of Massachusetts the following animal, the certificate No. of Dr. being satisfactory to this Board, said animal to be brought in in the following manner: , to enter the State at the city or town of , to be unloaded at the city or town of , to be driven directly to, and retained until further order upon, the premises of Mr. Street in said city or town.

On the arrival of said animal at the city or town above named you will immediately notify this commission or Mr. , inspector for said city or town; and said animal is hereby quarantined upon its arrival in said city or town until discharged therefrom by this Board or a member thereof, or by the above-mentioned inspector, who is hereby authorized so to do upon identification of the animal. *Cattle Commissioner.*

City or town of 189

I, , hereby certify that I inspected the animal accompanying this permit and the certificate of soundness attached thereto upon its arrival within the limits of the city or town of , and such animal in my opinion corresponded with the description contained in said certificate and permit, and I thereupon released it from quarantine.

No attempt has been made to forbid the introduction of animals which have not had a previous satisfactory test, but in such cases the following form of permit is used: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
52 VILLAGE STREET, BOSTON, 189 .

PERMIT TO BRING NEAT CATTLE INTO MASSACHUSETTS WITHOUT ACCOMPANYING CERTIFICATE OF VETERINARIAN.

(To be forwarded to this office immediately by agent or inspector, together with the duplicate quarantine order.)

To

City or town of State of

You are hereby authorized to bring within the limits of the Commonwealth of Massachusetts the following animal, the same not being

accompanied by a satisfactory certificate that the animal is free from tuberculosis. Said animal may be brought in in the following manner:
to enter the State at the city or town of , to be unloaded at the city or town of , to be driven directly to, and retained until further order upon, the premises of Mr. Street in said city or town.

On the arrival of said animal at the city or town above named you will immediately notify this commission or Mr. , inspector for said city or town, and at the same time surrender this certificate to the person notified.

Said animal is hereby quarantined upon its arrival in said city or town upon the premises above designated, or upon such other premises at which said animal may be found, at your expense or at the expense of the consignee or person in possession, where said animal will remain for a period of at least six days, or until my further order or that of the Board of Cattle Commissioners. *Cattle Commissioner.*

Boston, 189 .

The above animal, having been subjected to a physical examination and tuberculin test by , was freed 189 , condemned by warrant No. .

This provides that, after their arrival in Massachusetts, a quarantine of not less than six days shall be maintained; and a tuberculin test by a veterinarian, who must be approved by this Board, shall be made, at the expense of the owner or consignee. If any of the animals are found to be tuberculous, they are destroyed; and if the post-mortem examination shows disease, no compensation is paid.

Applications for this permission are answered in the first instance by the following form of circular letter: —

52 Village Street, Boston, Mass.

Dear Sir: — Replying to your inquiry regarding shipment of cattle into this State, permit me to hand you copy of General Order No. 9. Upon receipt of certificate of tuberculin test, made by a veterinarian who is vouched for by the Cattle Commission, or such Board as may have jurisdiction over contagious diseases among domestic animals in the State from which cattle are shipped, we will forward you permit for the animals.

To avoid enforced delay at this office, please see that your veterinarian has been properly certified by his State authorities before employing him, or that such certification reaches us before his certificates of tuberculin test.

If it is inexpedient to have the animals tested before shipment into this State, we will grant you permit to bring them to your premises, provided you will furnish us with certificate of test by an approved veterinarian, without expense to us. Otherwise, cattle can enter the Commonwealth only through the regular stations at Brighton, Watertown or Somerville.

Upon application, we will forward you the required number of duplicate blanks, to be filled out by your veterinarian.

Very truly yours,
(Signed) F. H. OSGOOD, *Chairman.*

In connection with the whole matter of the regulation of the importation of cattle, the following order was issued to railroad and transportation companies: —

COMMONWEALTH OF MASSACHUSETTS.

BOARD OF CATTLE COMMISSIONERS,
52 VILLAGE STREET, BOSTON, July 15, 1895.

To railroads, corporations, common carriers, their managers, agents, servants and attorneys, owning, leasing, operating or transporting over railroads whose lines or roads enter or lie within the limits of the Commonwealth of Massachusetts, and to all persons whom it may concern.

By virtue of the power and authority in us vested by law, and especially under the provisions of chapter 491 of the Acts of the year 1894 and chapter 496 of the Acts of the year 1895, you are hereby notified that tuberculosis, which is a contagious disease and is so recognized under the laws of this Commonwealth, exists among cattle of the several States and territories of the United States, the District of Columbia and Canada, and such localities are, in the opinion of this Board, infected districts.

Your attention is called to General Order No. 9, issued by this Board under date of July 8, 1895, and you are hereby further notified that, in order to prevent the importation of diseased animals, and as a means of suppressing such disease within this Commonwealth, this Board has passed the following order: —

General Order No. 10.

First. — General Order No. 4, dated Nov. 20, 1894, is hereby repealed.

Second. — No neat cattle brought from any State or territory of the United States, the District of Columbia, Canada or any other country without the limits of this Commonwealth shall be brought within the limits of this Commonwealth, except for delivery directly to the Union Stock Yards at the town of Watertown, the Boston & Albany Stock Yards at Brighton, within the city of Boston, or the premises of the New England Dressed Beef and Wool Company at the city of Somerville, except upon a written permit signed by the Board of Cattle Commissioners or some one of its members, and no neat cattle so brought for delivery at any of said points shall be unloaded, except in case of accident, at any point other than the said Boston & Albany Stock Yards at Brighton, the Union Stock Yards at Watertown, or the New England Dressed Beef and Wool Company at Somerville.

Third. — All neat cattle brought within the limits of this Commonwealth from any place designated in paragraph 2 hereof, except for delivery as provided in the preceding paragraph, must be accompanied by a written permit issued by this Board or some member thereof, which permit shall designate the number and description of the animals, and you are hereby forbidden to receive for transportation animals other than those designated in such permit.

Fourth. — If, for any cause, any such neat cattle are received by any of your agents within the limits of this Commonwealth at any place other than the Union Stock Yards at Watertown, the Boston & Albany Stock Yards at Brighton, or the New England Dressed Beef and Wool Company at Somerville, not accompanied by a written permit, as provided in paragraph 3 hereof, you will immediately notify this office by telegraph at your expense or that of the consignee, giving the place where said animals were received for shipment, the name of the consignee and destination of said animals. You will not remove said animals or permit them to be removed from the car or vehicle in which they are contained without a permit from this Board or some member thereof, except that if, by reason of the crowded condition of the car, or because of the long confinement of said animals within the same, or for accident or otherwise, it is deemed expedient by you or your agent to unload the same, such animal or animals may be removed by you from said car or vehicle without such permit; but in such case you will notify this office of your intention so to do, and you will not allow said animal or animals to go out of the possession of your agent or off of your premises where said animals are unloaded except upon obtaining such permit.

Fifth. — All neat cattle brought within the limits of the premises at Brighton, Watertown and Somerville, designated in paragraph 2 hereof, are hereby declared to be quarantined.

Sixth. — Any person violating the provisions of this order or of General Order No. 9 will be punished as provided in section 47 of chapter 491 of the Acts of the year 1894.

Seventh. — This order shall take effect upon the fifteenth day of July, 1895.

FREDERICK H. OSGOOD, *Chairman*,
CHARLES P. LYMAN, *Secretary*,
MAURICE O'CONNELL,
LEANDER F. HERRICK,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

The Board takes this opportunity to acknowledge the hearty co-operation and assistance rendered by the various railroad corporations and transportation companies entering the Commonwealth. Without such co-operation and assistance it would have been impossible for the Board to have kept an accurate account of animals transported across the State line, and the Board would have been unable in many instances to locate animals brought into the State contrary to these regulations.

The method of procedure differs with different roads, but is practically as follows: —

Roads entering from the north refuse to accept cattle for transportation across the State line without a permit being delivered at the time of shipment; where this is not forthcoming, the animals are not loaded until a permit is secured by telegraph or otherwise. In all other cases the animals are loaded and shipped with the distinct understanding that, if permission does not reach them at the State line, they will be immediately shipped to one of the regular stations at Brighton, Watertown or Somerville.

All roads within this Commonwealth refuse to switch cattle from off the tracks of any other road unless they are accompanied by the special permit, or have direct permission from the office. So thoroughly have these regulations been observed since the issuance of this order that no trouble whatever arises from this source at the present time. The only possible way for animals to gain entrance to the State other than upon permit, at the present time, is on the hoof; and infringements of this sort are guarded and prevented to some considerable extent through the local inspectors.

Inasmuch as the regulations put in force by this commission so vitally affected the agricultural interests of the adjoining States, because the movement of cattle was as a whole from those States to Massachusetts rather than in the opposite direction, the Board felt that it would be advisable to meet the authorities of the surrounding States, having control over the affairs in charge of this Board, that matters of mutual interest might be freely discussed and means of mutual assistance be agreed upon. Accordingly this Board invited the commissions of the New England States and the State of New York to meet them in a convention to be held in Boston. This convention was held on July 25 and 26, 1895, and was attended by representatives of the commissions of Maine, New Hampshire, Vermont, Rhode Island, Connecticut, New Jersey and Massachusetts, these States being represented by John M. Deering and Dr. George H. Bailey of Maine; Irving A. Watson and N. J. Batchelder of New Hampshire; C. M. Winslow, Homer W. Vail, H. M. Armes, V. I. Spear and J. O. Sanford of Vermont; E. S. Hough, G. L. Foskett and Clifton Peck of Connecticut; Geo. A. Stockwell of Rhode Island; Franklin Dye and George W. McGuire of New Jersey, and all of the members of the Massachusetts commission.

At this meeting the regulations issued by this Board concerning the movement of cattle into Massachusetts were thoroughly discussed, and it was unanimously voted to adopt these same regulations as governing all of the New England States. It was also voted that all of the States should co-operate in endeavoring to faithfully enforce them. A permanent organization was then formed, under the title of the Association of the Cattle Commissions of the New England States; after which the following resolution was passed by the new association, thanking the Bureau of Animal Industry of the Department of Agriculture at Washington for its material assistance: —

We, the undersigned Cattle Commissioners of Massachusetts, New Hampshire, Vermont, Maine, Rhode Island, Connecticut and New Jersey, assembled in convention at Boston on this twenty-fifth day of July, 1895, desire to take this opportunity of expressing to the Bureau of Animal Industry of the Department of Agriculture at Washington, and to its chief officer, Prof. D. E. Salmon, our high appreciation of the great value which the department has rendered our respective States by the dissemination of all of the facts, as fast as they have become known, in relation to tuberculosis among animals; the results of their valuable investigations with tuberculin, and particularly in furnishing us with a supply of tuberculin, which has been in all cases extremely reliable and satisfactory in its results.

We feel confident, had it not been for this action of the Bureau, and the kind, almost personal care, given us by its chief, that the advances which we feel have recently been made by us in this whole matter could not have been accomplished but by the expenditure of a very great deal more money and much valuable time by our several States. (Signed)

> Frederick H. Osgood, *Boston*, *President.* C. M. Winslow, *Brandon*, *Vt.*, *Secretary and Treasurer.* C. A. Dennen, *Boston*, N. J. Batchelder, *New Hampshire*, V. I. Spear, *Braintree*, *Vt.*, John M. Deering, *Saco*, *Me.*, Obadiah Brown, *Rhode Island*, Clifton Peck, *Connecticut*, *Executive Committee.* Charles P. Lyman, Maurice O'Connell, L. F. Herrick, *Massachusetts.* Irving A. Watson, *New Hampshire.* Homer W. Vail, J. O. Sanford, *Vermont.* George H. Bailey, *Maine.* Geo. A. Stockwell, *Rhode Island.* E. S. Hough, G. L. Foskett, *Connecticut.* George W. McGuire, Franklin Dye, *New Jersey.*

While, as has been shown, the requirements of General Order No. 9 were accepted, and, so far as possible under the various laws, put into practice by all of the New England commissions, one or two of the States have made further provisions of their own. Those desiring to ship animals from Vermont into any other of the New England States can have them subjected to the tuberculin test by paying the actual cost of the veterinarian's services, provided application is made to C. M. Winslow, Secretary, Brandon, Vt., who will then send a veterinarian of his own selection, and supplied with the tuberlin which is furnished, free of charge, by the Bureau of Animal Industry at Washington, provided that a duplicate record of the test, in each instance, is sent to that Bureau. This provision makes the certificate furnished the Massachusetts Board, from Vermont, the most valuable of any received, as all such examinations are made under the direct supervision of the State authority.

The provision under which the Board of Cattle Commissioners of the State of Maine certify to the competency of veterinarians within their borders to make the tuberculin test upon animals for shipment to other States provides that a return of all tests made by such veterinarians, where any evidence of tuberculosis exists, shall be immediately forwarded to the Board of Cattle Commissioners. This failing, certification of such veterinarian is at once revoked.

The system inaugurated under General Order No. 9 has now been in operation for a period of more than five months, and has proved, in the opinion of the commission, extremely satisfactory. It has resulted in the saving of the entire expense of maintaining quarantine stations at the markets of Brighton, Watertown and Somerville; it has permitted dealers in cattle to bring in their animals at the regular time, properly prepare them for market and sell them on the regular market day, without material interference; it has, in the opinion of the commission, resulted in preventing the introduction of a large amount of tuberculous animals; and, further, it has enabled the owners to have their animals examined under such conditions as will render the test accurate, if properly applied, and where they may also have the advantage of any indemnity that is paid by their own States.

From the first day of July to the first day of December the records at the markets of Brighton, Watertown and Somerville show: —

Number of Western cattle received for export, which, therefore, did not come under the provisions of General Order No. 9: —

Brighton,	–
Watertown,	66,312
Somerville,	13,409

Cattle brought from without the State and released for immediate slaughter, which, therefore, were not required to have accompanying tuberculin certificate: —

Brighton,	8,165
Watertown,	1,095
Somerville,	1,249

Cattle tested without the limits of the Commonwealth, and accompanied by certificate satisfactory and approved by the Board: —

Brighton,	2,553
Watertown,	3,960
Somerville,	81

Cattle entering this market not accompanied by proper certificate, which were quarantined for a period of six days and then tested with tuberculin: —

Brighton,		712
Watertown: —		
From New York,	155	
From New Hampshire and Vermont,	44	
		199
Somerville,		76

Number condemned as tuberculous: —

Brighton,	2*
Watertown,	3
Somerville,	4

Number found to be diseased on post-mortem examination: —

Brighton,	2
Watertown,	3
Somerville,	4

As the result of the new regulations, it will be seen that only 14.9 per cent. of the animals arriving at Brighton, Watertown and Somerville, for purposes other than immediate slaughter, or for export, were required to be examined. Of the 987 animals examined, only 9 were pronounced diseased on tuberculin test, and all of these, upon being killed and examined, were found to be diseased.

While the tests so made were but few, the indication from this experience is that tuberculin can be used with almost absolute accuracy at these markets, if it can be applied under proper conditions; and therefore, if it ever becomes necessary to again inaugurate the compulsory system of examination of all cattle coming to these markets, it must be under some system whereby the animals can be kept in quarantine, under normal conditions, for a period of at least six days.

In regard to the certificates accompanying animals tested without the State, the commission desires here to call the attention of your honorable body to the fact that, while every possible precaution is exercised to insure good, reliable work, as has already been shown, this Board has no actual or personal knowledge as to the conditions under which the test has been applied in any given instance, and it cannot therefore be held to be responsible for any errors that may be made; but, out of the total number of animals which have entered the State in the past six months, under these certificates, the attention of the commission has been called to but four cases wherein an animal has proved to be tuberculous. In most of these cases, as far as can be ascertained, the difficulty seems to have been that the animals were tested under abnormal conditions, such as those met by the commission in its former work at Brighton, Watertown and Somerville. In the earlier part of this work the commission found some certificates which were unsatisfactory because the examiners had failed to make a sufficient number of temperature readings after the tuberculin had been injected; and accordingly a further order was issued, reiterating, in part, General Order No. 9, that "the temperature must be registered from the tenth hour after the injection every two hours until the twentieth. Satisfactory test is impossible when the initial temperature is higher than $102\frac{3}{5}$."

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* There were eighteen other animals whose temperatures before inoculation were higher than that upon which action is taken by this Board. Consequently the animals, although subjected to the test, were continued in quarantine for a subsequent test at such time as they should be found to be in normal condition, but upon request of the owners they were released for immediate slaughter.

It will be seen that, under the system adopted by the commission at the markets of Brighton, Watertown and Somerville, since the eighth day of July, the cattle offered for sale in these markets are of two classes: those coming from without the State, accompanied by a certificate, approved by the Board, that the animals have been tested with tuberculin and found free from tuberculosis; and those coming from points within the State, which are sold in the market without restriction, and which, therefore, have not been subjected to a tuberculin test. The commission has had no means within its control to obtain any records of the actual sales at these markets, for the purpose of determining the relative selling value of these two classes of animals; it has, however, carefully observed the general condition at the markets, and, so far as it has been able to judge, the tested cows have been sold more readily and at a higher price than untested animals.

There are a large number of buyers at these markets who will not buy animals unless they have been tested with tuberculin and found free from disease; it also appears that the number of these buyers is constantly increasing. There are others who state that they are as ready to buy untested cattle as tested; but, so far as the observation of the commission has gone, these buyers purchase large numbers of tested cattle, at higher prices than the untested, and as a rule the untested cattle are the last to be sold.

In the case of animals coming into the State and arriving at points other than the regular stations of Brighton, Watertown and Somerville, upon special permits, from June 5 to November 25 permits for 7,677 animals have been issued. Of these, 7,078 were accompanied by proper certificates of tuberculin test, which were approved by the commission and the animal discharged from quarantine; 601 were not accompanied by satisfactory certificates, and were held for a period of six days or more, and tested with tuberculin; 16 of these were condemned as tuberculous and destroyed, and all were found diseased upon post-mortem examination.

Systematic Work.

At the time we submitted to your honorable body the report of this Board for the year 1894, the commission was conducting a systematic examination of all neat stock in the counties of Nantucket, Dukes and Barnstable, and at that time this examination, covering the whole of the Island of Nantucket, was fully described upon page 20 of that report. After leaving Nantucket, the same systematic work was continued throughout Dukes County. In this county 1,300 animals were examined, of which 3 were condemned as tuberculous, all of which showed unmistakable signs of that disease upon post-mortem examination. A fourth animal, which showed no reaction to tuberculin, was condemned and killed on account of actinomycosis.

The work in Dukes County was begun on the twenty-ninth day of December, 1894, and was completed upon the twenty-second day of February.

The examination in Barnstable County was begun March 4, at Provincetown, following which the entire eastern portion of this county was examined, up to and including the towns of Harwich and Brewster, where the work ceased upon the twentieth day of May. There were 1,556 animals examined in this county; 6 were condemned, all of which were found upon post-mortem examination to be diseased. In addition, one animal in Truro showed no reaction to the tuberculin test, but was condemned upon physical examination, and upon post-mortem was found free from tuberculosis.

Up to June 4, 1895, when the new law became operative, all the animals in the following towns in Barnstable County had been examined: Provincetown, Truro, Orleans, Wellfleet, Eastham, Chatham, Brewster and Harwich. The work was stopped on the twentieth of May, by reason of failure of sufficient appropriation. An additional reason for stopping at this point was that the town of Dennis, the next in order after leaving Brewster and Harwich, extends entirely across the Cape, thus in itself forming a natural line, in which a good quarantine against incoming cattle might be maintained at a comparatively small expense.

Up to the time of the passage of the law of 1895 the commission had maintained a quarantine against the introduction of all untested cattle throughout the counties where it was doing systematic work. Any person desiring to bring cattle into these counties was only permitted to do so after such animals had been subjected to the tuberculin test. This regulation was necessarily based upon the power in the commission to compel the owner to subject such animals to the tuberculin test. With the passage of the law of 1895 the Board was deprived of this power, and consequently any quarantine maintained by the commission to protect the territory where the systematic examination had been completed, after that time, would have been a violation of at least the spirit of the act. Therefore, on June 4, with the passage of the new law, the quarantine hitherto maintained about these counties was adandoned; and since that date all persons have had the uninterrupted privilege of taking such animals as they desired into this territory.

Inasmuch as the attention of the commission has been called to statements which have been made to the effect that there was a general opposition to the compulsory use of tuberculin, the Board desires here to say that in its systematic work in these counties it experienced substantially no opposition from the owners of the animals tested, and as a rule secured the hearty co-operation of such parties, who seemed to be desirous of having their herds tested and all diseased animals removed, if any were found. In this connection many instances might be cited where parties in these localities who were at first opposed to the use of tuberculin have, upon seeing it used, become convinced of its reliability and usefulness. In the county of Barnstable no opposition was met by the commission in its work until after the agitation of the matter regarding the restriction of the use of tuberculin before your honorable body last year, after which time more or less opposition was experienced in the town of Harwich, where the work was then being conducted.

So far as the commission had knowledge, the owners of cattle in Dennis were desirous, at the time when the commission was obliged to abandon its work, to have the animals in that town examined.

Examination of Animals quarantined by Inspectors.

An important branch of the work of this commission in suppressing tuberculosis is the examination of cattle quarantined by the local inspectors as suspected of being tuberculous. More or less of these animals are being constantly quarantined by these inspectors throughout the year, but the great bulk of them are usually so isolated, as the result of their regular inspections. This year, as has already been stated, the first regular inspection was ordered to be begun the 1st of October. The inspectors, however, as heretofore, were required to inspect and quarantine, at any time, all animals which they had reason to suspect were affected with any contagious disease. The quarantines placed by inspectors upon cattle supposed to be tuberculous, since our last report, are from Dec. 15, 1894, to June 5, 1895, 1,776; from this last date to Dec. 15, 1895, 2,239, — a total of 4,015. Of the animals quarantined between Dec. 1, 1894, and June 5, 1895, all were subjected to the tuberculin test, and 795 condemned as tuberculous. Post-mortem examination disclosed the presence of the disease in the case of 780; in 15 no lesions of the disease were found. It will thus be seen that 43.9 per cent. of those quarantined were diseased.

Under the provision of section 14 of chapter 496 of the Acts of 1895, it is provided that, in the absence of written consent, no Massachusetts animal shall be subjected to the tuberculin test unless such animal has been already condemned as tuberculous, upon physical examination, by a competent veterinarian. Whenever, therefore, reports of quarantine are received from inspectors who are not also veterinarians, a "competent" man is at once sent to make a physical examination of suspected animals. It has further been the practice of the Board to obtain, if possible, from the owners of these animals, permission in writing to apply the tuberculin test as a means of reaching a final decision. This permission has been given in all but four or five of the instances. In two of these, after a physical examination made by a competent veterinarian had failed to disclose the presence of tuberculosis, the animals were liberated. In the other cases they were condemned by a similar physical examination, and examined with tuberculin. All of these animals — being those that were quarantined between June 5 and Dec. 15, 1895 — except the two above mentioned were subjected to the tuberculin test; 1,000 were condemned as tuberculous and destroyed, and upon post-mortem examination disease was found to be present in 989 animals. In 3 cases, wherein the post-mortem examinations were made by the agents of the Board, no evidence of disease was found; in the remaining 8 the post-mortem examinations were performed by local inspectors, who reported them to have been free from the disease.

It is impossible to give the accurate returns, at the time of making this report, of the total examinations made upon these inspectors' quarantines, for the reason that the Board is not yet in receipt of returns of all the examinations; and it is probable, therefore, that this total of 1,000 represents the number diseased in a figure of one or two hundred less than the total of received quarantines, as hereinafter given.

TESTS MADE UPON VOLUNTARY REQUESTS.

Prior to June 4 it had been the policy of the commission not to make tests outside of the counties in which the systematic work was being conducted, except in cases where the animals had already been quarantined by the local inspector. In establishing this rule the commission was influenced by the fact that, with the appropriation at its command, it did not seem practicable to carry on both classes of work. There were, however, at this time numerous owners of neat stock throughout the State who desired to have their herds tested with tuberculin, and who were not willing to wait until they could be reached, in the natural course, under the systematic examinations. Arrangements, therefore, were made to authorize the examination of such herds wherein the owner in all instances was willing to pay the expense of making the examination, and the veterinarian employed by him was a fully qualified man in good standing. In such cases the result of the examination, showing in detail the thermometrical readings taken prior to and after the administration of the tuberculin, was transmitted to the commission for inspection and approval. In this class of work, prior to June 4, 1,514 animals were examined, of which 289 were condemned and found tuberculous, showing 19 per cent. of disease. Upon June 4 the law of 1895 was passed, which restricted the use of tuberculin, so that it became impossible for the commission to further continue its systematic work; and as soon thereafterward as possible the commission gave careful consideration to the matter of carrying out the provisions of section 14 of this law, which provides that tuberculin may be used as a diagnostic agent on any animal or animals in any other (than Brighton, Watertown and Somerville) portions of the State, upon the consent in writing of the owner or person in possession thereof. After giving the matter careful consideration, the Board decided that the best method of eradicating the disease, under the restrictions placed by this act, would be to make tests of entire herds. In arriving at this decision the Board was influenced by the opinion that such a measure would result in the most economical method of administration, because a large number of animals could be tested at one time, by the same agent; that it was more likely to do permanent good, because, by removing the disease from the entire herd, the owner would have an interest, thereafter, in seeing that the disease was not re-introduced into the herd, thus making each owner practically a quarantine agent against untested cattle; and that the cleaning up of an entire herd enabled the public to ascertain readily the sources from which a supply of uncontaminated milk or an animal free from tuberculosis might be obtained. Accordingly the Board adopted the rule that it would test all herds where written application was made by the owner or person in possession, in the order in which such applications were received, so long as the appropriation at the command of the commission was unexpended. These applications are all made upon uniform blanks, of which the following is a copy: —

VOLUNTARY REQUEST FOR TUBERCULIN TEST.

CITY OR TOWN OF .

To the Board of Cattle Commissioners, 52 Village Street, Boston, Mass.

GENTLEMEN: — Believing in the value of tuberculin as a diagnostic agent for the detection of tuberculosis in cattle, and believing that no injury results therefrom to animals found free from the disease, I hereby request that you subject my herd, consisting of the following animals, to wit, to the tuberculin test, to determine whether or not any of said animals are affected with tuberculosis; this test to be made at the expense of the Commonwealth.

And I agree that thereafter I will observe the sanitary regulations prescribed by the Board of Cattle Commissioners, and will not introduce into said herd any animals without having them first subjected to the tuberculin test.

I further certify that I am the true and lawful owner of said animals, that of said animals have been owned within the State six months continuously prior to the date hereof.

Date received,
Date examined,
No. examined,
No. released,
No. condemned,
Amount approved for animals destroyed,
Warrants No.
Expense,

Upon receipt of these requests, a member of the commission, or an agent of the Board who is also a duly qualified veterinarian, visits the premises where the herd is located. Before the test is applied a careful physical examination is made of every animal in the herd, after which they are subjected to the tuberculin test, and animals which are by these means considered suspicious are condemned and destroyed under the provisions of the act.

The first application which was received by the commission for this class of work was on July 15, 1895, from the town of Cummington. Upon this application 26 animals were examined, 10 of which were found to be diseased, were condemned and destroyed; since which time the commission has received nine additional applications for test in this town. In the early part of this work the applications which were received by the commission, while numerous, were few in comparison to the number received afterwards. Up to December 18 the commission has received 535 such applications. The number received, month by month, has been as follows: —

July,	10
August,	68
September,	74
October,	92
November,	138
December, to the 18th,	153
Total,	535

The following table shows the cities and towns from which voluntary requests for tuberculin tests have been received, those which have been examined and those which remain to be examined : —

City or Town.	Number of Herds already tested.	Number of Applications now in Office.	City or Town.	Number of Herds already tested.	Number of Applications now in Office.
Adams,	–	1	Fall River,	–	1
Amherst,	2	–	Framingham,	–	4
Andover,	–	1	Groton,	3	6
Ashby,	15	4	Gardner,	10	5
Ashfield,	2	3	Grafton,	–	1
Ashland,	–	1	Greenfield,	–	5
Athol,	1	–	Haverhill,	2	1
Auburndale,	1	–	Hampden,	1	–
Barre,	26	23	Hadley,	1	1
Bolton,	1	–	Holyoke,	1	–
Billerica,	1	–	Hubbardston,	–	1
Bridgewater,	2	2	Holland,	1	–
Burlington,	1	1	Holliston,	1	–
Blandford,	–	1	Hyde Park,	–	1
Blackstone,	–	1	Hatfield,	1	–
Becket,	–	8	Harvard,	–	5
Brockton,	–	2	Hinsdale,	–	1
Buckland,	–	1	Hopkinton,	–	1
Chester,	59	–	Hardwick,	–	2
Chesterfield,	1	–	Hingham,	–	1
Cheshire,	14	2	Huntington,	–	5
Concord,	1	–	Ipswich,	1	–
Chelmsford,	1	1	Littleton,	4	1
Cummington,	1	9	Lexington,	1	2
Charlton,	–	1	Lee,	1	4
Colrain,	–	2	Lenox,	–	3
Dunstable,	22	–	Leyden,	–	1
Dalton,	12	–	Marlborough,	11	–
Dudley,	–	4	Marshfield,	2	–
East Longmeadow,	2	1	Milton,	1	–
Erving,	1	–	Medway,	–	1
Franklin,	2	–	Mansfield,	–	1
Foxborough,	1	–	Middlefield,	–	2

CITY OR TOWN.	Number of Herds already tested.	Number of Applications now in Office.	CITY OR TOWN.	Number of Herds already tested.	Number of Applications now in Office.
Melrose, . . .	–	1	Sunderland, . .	1	1
Millis, . . .	–	1	Shelburne, . .	–	1
New Marlborough,	2	–	Southborough, .	10	6
Norton, . . .	2	5	Sandisfield, . .	–	4
Needham, . .	1	–	Springfield, . .	–	1
North Reading, .	–	1	Southbridge, .	1	–
North Hadley, .	–	1	Stow, . . .	1	–
Northborough, .	–	2	Sheffield, . .	1	–
Northbridge, . .	1	–	Scituate, . .	1	–
Oakham, . . .	–	1	Townsend, . .	19	7
Paxton, . . .	1	3	Tyngsborough, .	1	–
Pepperell, . .	29	5	Tyringham, . .	–	14
Peru, . . .	–	1	Weymouth, . .	1	–
Pittsfield, . .	–	1	Worcester, . .	6	1
Prescott, . . .	–	1	Westminster, .	1	2
Palmer, . . .	1	–	Warren, . .	1	1
Quincy, . . .	1	–	West Dedham, .	2	1
Rehoboth, . .	–	1	Westborough, .	5	11
Reading, . . .	–	1	Webster, . .	1	–
Royalston, . .	2	–	Westhampton, .	1	1
Shrewsbury, . .	–	1	Wilmington, . .	1	–
Sudbury, . .	–	1	West Boylston, .	1	–
Sherborn, . .	4	2	Waltham, . .	1	2
Sutton, . . .	2	2	Whitman, . .	–	1
Savoy, . . .	–	1	Wilbraham, . .	–	3
South Hadley, .	–	1	Williamsburg, .	1	3
Sturbridge, . .	–	1			
South Deerfield, .	–	2	Herds, . .	314	221

Upon these applications the following number of animals have been examined in the different counties, prior to December 1: —

Middlesex, ...	1,263
Worcester, ...	1,058
Hampshire, ...	340
Essex, ...	67
Berkshire, ...	279
Hampden, ...	64
Norfolk, ...	140
Plymouth, ...	58
Bristol, ...	13
Franklin, ...	69
Total, ...	3,351

Between December 1 and 16 inclusive there have been in addition 742 animals examined, making the total number to December 16, 4,093. Of this total number, 1,081 were condemned upon tuberculin test and killed. In 1,079 cases the disease was found upon post-mortem examination, and in 2 cases no evidence of disease was found. It will thus be seen that the percentage of disease in these herds was 26.3 per cent. and the percentage of error was $\frac{185}{1000}$ of 1 per cent. In all of these cases the animals were subjected to the tuberculin test under normal conditions, and the commission and its agent were accorded every assistance by the owners of the herds, again showing the great value of having the animals surrounded by persons and conditions with which they are perfectly familiar and friendly while undergoing the test, and the remarkable accuracy of the test under such conditions.

We desire, in this connection, to call your attention to the fact that the herds which were tested upon these voluntary requests were, as a rule, those which were being kept for dairy purposes, being apparently in good, healthy condition, in which, although the owners in numerous cases suspected that disease might be present, it was practically impossible for them to pick out diseased animals by means of any physical examination ; and, believing that the disease could be removed only by the use of tuberculin, they requested the Board to make the examination. In these herds, while the members of the commission might and did pick out here and there an animal upon physical examination which they suspected of being tuberculous, as a whole there was nothing to indicate the disease ; nor was it possible, by such means, to pick out or even suspect the existence of the disease in any more than an occasional case here and there among the animals which were submitted for examination.

In every county in which tests have been made upon voluntary requests disease has been found to a greater or less extent among the herds so tested. Of the 314 herds examined, 24 herds have been found to be absolutely free from disease. While the percentage of disease (26.3) found is surprisingly large, it compares favorably with that found under similar conditions in other parts of the world, where the examinations have been as rigidly made as here; as, for example, in the case of New York, where 34.9 per cent. of the animals examined under similar conditions were found to be diseased.

In attempting to deduce from these figures the probable amount of disease in the State, it should be remembered that, while these examinations cover a large number of animals, as compared with the total number in the State, they are but few, and in the majority of cases the owners had some reason to suspect that disease might be present, although they had no means of judging to what extent.

The table showing the voluntary requests received by the commission also shows that applications have been received to test 221 herds, embracing 3,346 animals, which have not yet been attended to on account of lack of sufficient appropriation. In addition to the examinations made upon these voluntary requests, further tests have been made by private veterinarians and approved by this Board covering 584 animals, of which 90 were condemned, and 89, or about 15.2 per cent., were found to be diseased.

The work of the commission in attending to the examination of herds upon voluntary requests has been extremely satisfactory. It has resulted in the removal of a large number of diseased animals which otherwise would be the source of the milk and food supply of some considerable number of people. It has demonstrated that the disease exists in almost every county of the State, and it has further demonstrated that in tuberculin we have a reliable agent, by means of which we can with substantial accuracy pick out all cases of the disease where the germ has gained any lodgement whatever in the animal's body.

The commission has experienced during the past year more or less scepticism as to the value of tuberculin as a diagnostic test, and there has been a feeling, to a greater or less extent, that the use of tuberculin is an injury to sound animals. The Board has found, however, in connection with this class of work, in almost every case wherein herds have been examined upon voluntary request, that upon the completion of its work numerous requests were immediately received from the owners of cattle in the immediate neighborhood; and, as the work has progressed, the confidence in the use of tuberculin has grown and the demand has increased to the extent which has already been shown.

In a large percentage of the cases where the animals have been condemned by tuberculin the owner or his representative has been present at the post-mortem examinations, and the commission has no knowledge of any instance in which the owner has not been satisfied with the result as finally declared.

Before leaving the subject of voluntary requests, the commission feels that it should call the attention of your honorable body to this class of work, as bearing upon the question of the best method of procedure in the matter of the suppression of tuberculosis among cattle. Under the law which is now in force, the owner receives for every animal destroyed as tuberculous by order of the commission, provided the animal has had the required residence in the State, the full value thereof at the time of condemnation, not exceeding the sum of $60 for any one animal. The average amount received by such owners in compensation, under the provisions of this act, has been about $35. Under the law of 1894, which provides for the payment of one-half the sound value, the average price paid for such animals up to the fifteenth day of December of last year was $18.36. From the fifteenth day of December up to the fourth day of June, also half value, the average price was $21.* In addition to this, the State bears the expense of making the examinations, so that, whether the work is done by systematic examination or in response to voluntary requests, the owner is given an opportunity, which, in the opinion of the commission, is a very valuable one, to have the sources of the disease removed from his herd without expense to himself, and without loss growing out of the destruction of any animal, — unless, of course, such animal has a fancy or pedigree value.

In either class of work State animals only are tested, and every diseased animal destroyed removes one more source of contagion and menace to the public health through the sale of the milk derived therefrom. In the case of the examinations conducted on the systematic plan, the commission is working by force of law, and to a greater or less extent without the co-operation of the owners; whereas, in the case of examinations made upon voluntary request, it works, in every case, with the co-operation and assistance of the persons in charge of the herd. Other things being equal, it follows that better work can be done under the latter conditions than under the former. There is no doubt that, in examining herds upon request, the commission is removing a very great amount of diseased animals which are scattered throughout the State, and which are the source of the local milk supply; and it is also removing the disease from barns, many of which, it is to be hoped, will be protected by the owner against the further introduction of disease. The examination of herds upon voluntary request has not only given the owner an opportunity to remove the source of contagion, but in repeated instances has resulted in a public demand by the consumers of milk in such city or town that the herds from which they derive their milk shall also be tested. This has greatly assisted in the cleaning up of localities of greater or less extent, in substantially the same way as would be done upon the principle of systematic examination.

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* Under the law of New York, which provides for the payment of half compensation, similar to our law of 1894, the average price paid for animals destroyed has been $23.25.

While this system of examination furnishes an opportunity to the owner to remove the disease from his herd and to the commission to remove the sources of contagion therefrom, it must also be remembered that there are numerous owners of herds who have not and probably will not make applications for such tests; although it is the feeling of the Board, based upon its experience at the present time, that the number of such people will decrease at a very rapid rate as the advantages of the test become more widely known, and as such persons find that the public refuses to receive the product from untested herds.

Another advantage of the herd work is, that it gives to the owners of neat stock an opportunity, if they so desire, to immediately clean up their herds, and by this means to furnish milk free from tuberculous taint to their customers; whereas, by the systematic work, no direct advantage is derived by the owners outside of the counties in which such work is being conducted, and thus it would result that certain portions of the State would be without this advantage for possibly many years to come. On the other hand, it must be remembered that, tuberculosis being a contagious disease, the State cannot expect to eradicate it by means of examinations of isolated herds upon written request. Such a method will diminish the risk of transmission of the disease to the human family, through the milk, by the destruction of just as many animals as are found to be diseased, and undoubtedly will to a great extent, in certain localities, result in the suppression of the disease. It cannot for a moment, however, be considered as adequate, if we hope or desire to eradicate tuberculosis. No plan can do that which does not eliminate every diseased animal and thoroughly disinfect the premises which have been inhabited by it; and, just so long as tuberculous animals are left within the State, such animals will act as a menace to others with which they may at any time be brought in contact, and may in this way constantly create new sources of contagion.

It may be argued that, by cleaning up herds upon voluntary request, the commission is doing in a small way what is being done on a large scale by systematic examination; but after these herds are examined it is impossible to practically quarantine them against the introduction of new sources of contagion. Such animals are during a considerable portion of the year turned out to pasture, where they may come in contact with animals in adjoining pastures which have not been subjected to the test, and thus the disease may re-enter the herd. Again, while the owner may in most cases have an interest in protecting his herd, cases are likely to arise where, under special pressure, he may introduce untested animals, which may and probably will result in the reinfection of the herd. As a question of ultimate policy, looking to the eradication of the disease, the commission has not changed its view, as heretofore expressed, that no method can be devised to accomplish this except one which is based upon a thorough systematic examination, with tuberculin, of all animals within the State, the thorough disinfection of all premises where the animals have been, and stringent quarantine restrictions against the introduction of untested animals.

On the other hand, for the present there is no doubt that the examination of herds upon voluntary request is a great benefit to the agricultural community, and to the public who are the consumers of their product. It is impossible for the commission, with the assistance which it is able to get, and with the appropriation which has been or is likely to be made, to do both classes of work; and the Board is to-day in receipt of voluntary requests in greater numbers than it is able to attend to.

TUBERCULOSIS.

As experience ripens, we find that the contagious principle of bovine tuberculosis is fully as strong or stronger than was at first supposed. The reason for this seems to be entirely embraced in the fact that in tuberculin we have a much more perfect diagnostic agent than we have ever had previous to this time; and the results of investigation show that tuberculosis may be very quickly extended from the diseased animal to other healthy animals with which it may come in contact, but that in a large majority of cases the extension is exceedingly subtle. The animals, although they become affected, do not become sufficiently so to be attractive in their symptomology; whereas, with the use of tuberculin it is found that the animals are affected very quickly after exposure, and that the disease is largely disseminated throughout the herd; that it is received and amplified, by the newly infected, in a very small lesion, situated, more probably, in some of the deeper-seated glandular structures of the body, and then, because of the inherent resisting power of the animal, it does not receive a further development until after the lapse of some time, extending even to years in many cases.

Prevalence.

Upon page 28 of our report for last year will be found a statement as to the prevalence of this disease in other countries, gathered from such statistics as the commission was then able to obtain, and a statement that the Board had not been able, up to that time, to gather information sufficient to make any valuable estimate for determining the amount of such disease in Massachusetts. As the result of the experience of the Board up to that time, however, it was found that 24.58 per cent. of animals reported as suspicious by local inspectors were found to be diseased; 6.21 per cent. of animals examined at Brighton, Watertown and Somerville, and .9 per cent. of the animals examined on the Island of Nantucket. From all of these figures and such other data as could be gathered, the Board was then of opinion that the amount of disease in the State might be in the neighborhood of 10 per cent., which, under the circumstances, was a mere estimate.

Since the introduction of the tuberculin test, the whole number of animals examined by the Board with this agent is 26,958: —

Number condemned as tuberculous,		4,389
Percentage of diseased animals in all classes of work,		16
From Dec. 15, 1894, to Dec. 15, 1895, the total number of animals reported by the local inspectors and quarantined as suspicious, which have been examined by the Board, is		4,015
Number condemned as tuberculous,	1,795	
Percentage of diseased animals,	44.7	
From June 5 to December 16 the total number of animals examined upon voluntary request is		4,093
Number condemned as tuberculous,	1,081	
Percentage of disease,	26.4	
In the counties of Dukes County and Barnstable the total number of animals examined is		2,856
Number found to be tuberculous,	9	
Percentage of disease,	.31	
Total number of carcasses examined in slaughter houses,		18,738
Number condemned,	192	
Percentage of disease,	1	
Total number of animals examined at Brighton, Watertown and Somerville, from December 26 to April 30,		6,270
Number found diseased,	256	
Percentage of disease,	4	

Since the adoption of the new regulations relating to interstate cattle, substantially all of these animals are examined before coming here, therefore statistics of no value can be gathered from the few that have been examined and killed in this State. The percentages shown above vary so widely, according to the class of work, that the commission feels again that it is impossible to make any reasonably accurate statement as to the actual percentage of the disease existing within the State. In estimating the percentage of disease, the result of the examination of animals quarantined by local inspectors is naturally very largely in excess of the actual amount of disease in the State, because these are animals which present such symptoms as render them suspicious of being tuberculous. Whether or not the figures gathered from the herd work may be considered as showing the average amount of disease in the

State is also a matter of some doubt, for the reason that in a large percentage of these cases, at least, the owners presumably suspected the disease to be present before requesting the test. In this connection it is also of interest to note the amount of disease found in various herds which have been examined by the commission upon voluntary request.

The following table shows a number of miscellaneous herds in which a large percentage of disease has been found: —

Voluntary Requests.

City or Town.	Number Tested.	Number Condemned.
Haverhill,	41	21
Littleton,	27	20
Gardner,	28	11
Barre,	10	10
Norwood,	10	10
Blackstone,	10	10
Quincy,	11	7
Dunstable,	14	13
Ashby,	9	9
Waltham,	36	26
Dalton,	16	9
Dedham.	48	26
Marshfield,	15	13
Whately,	16	15
Palmer,	40	18
Webster,	45	20
Sherborn,	36	25
Burlington,	15	14
Cheshire,	24	10
Cheshire,	27	10
Shelburne,	37	22
Ashfield,	40	32

In other words, the percentage of disease in herds thus far examined varies all the way from 0 up to 100 per cent. This table also shows that the disease is not by any means restricted to the more closely populated districts. Large percentages of disease are naturally found in localities where, from the nature of the business carried on, a large number of animals are exchanged. In localities where animals are raised on the farm and the supply kept up in that way, the percentage of disease is generally found to be small, excepting that, when disease has once been introduced into any given herd, large numbers of cases are almost surely found in that herd, whatever the conditions are under which it is maintained. Statistics gathered from the returns from slaughter houses are, in the opinion of the commission, of little value in determining the prevalence of the disease; because, in the first place, under the present law all such diseased carcasses are, if found, destroyed without compensation to the owner; and, in the second place, this examination as at present conducted is, as has been shown, not by any means full. In other words, people will not slaughter animals in licensed slaughter houses in this State if there is any symptom of unhealthiness about them.

The records of the Copenhagen slaughter houses for the years 1890–93, inclusive, show: —

Number of oxen and cows slaughtered,		132,294
Number of these found diseased with tuberculosis,	23,305	
Percentage,	17.7	
Calves slaughtered,		185,765
Number found diseased with tuberculosis,	369	
Percentage of disease,	.2	

In the Berlin slaughter houses, for the years 1892–93: —

Total number of oxen and cows slaughtered,		142,874
Number showing evidence of tuberculosis,	21,603	
Percentage of disease,	15.1	
Total number of calves slaughtered,		108,348
Number found tuberculous,	125	
Percentage of disease,	.11	

Bollinger, in the Munich "Medical Weekly," states: —

> While it has been supposed that neat stock generally are affected with tuberculosis to the extent of $\frac{2}{3}$ per cent., excepting milch cows, which were supposed to be affected to the extent of $\frac{6}{7}$ per cent., the statistics from the slaughter houses, and by the use of tuberculin, show this disease to be much more widespread.
>
> In a slaughter house at Berlin, from April 1, 1891, to April 1, 1892, 15 per cent. of the 21,000 animals slaughtered were found tuberculous. In the year 1893, in twenty towns in the kingdom of Saxony, out of 69,164 animals, 12,630, or 18.26 per cent., were affected. As showing the percentages of disease among the various classes of animals killed, the following statement is interesting: —
>
> 16,128 bulls killed, 1,947, or 12.07 per cent., infected.
> 23,851 oxen killed, 3,437, or 14.41 per cent., infected.
> 28,784 cows killed, 7,175, or 24.92 per cent., infected.

Leipzig Statistics.

[Figures mean per cents. of those slaughtered.]

YEAR.	All Animals Infected.	Bulls.	Oxen.	Calves.	Cows.
1888, ...	11.1	11.2	7.3	5.0	17.5
1889, ...	14.9	11.8	13.7	9.18	19.4
1890, ...	22.3	17.8	20.9	9.4	27.8
1891, ...	26.7	18.4	27.7	13.2	31.1

At the slaughter houses in Schiverin the following statistics are given as infected: —

YEAR.	All Kinds.	Oxen and Bulls.	Cows.
1886, ...	10.70	6.4	12.83
1887, ...	11.03	4.9	13.50
1888, ...	12.89	6.6	14.95
1889, ...	12.35	6.5	14.52
1890, ...	15.69	5.0	19.39
1891, ...	18.60	6.9	23.37
1892, ...	21.47	13.45	24.66
1893, ...	26.60	21.46	28.50
1894, ...	35.00	34.00	35.70

Finally, Bollinger gives the figures presented by Bang to the Congress at Budapest, concerning the spread of tuberculosis in Denmark: —

On the 327 farms 8,401 animals were subjected to the tuberculin test, and 3,362 reacted, or 40 per cent. At a farm in Seeland, of the 208 animals tested, 80 per cent. of all the cows and 40 per cent. of the oxen and calves reacted. The cows that reacted were separated from the healthy ones, and as they calved the calves were taken and fed on sterilized milk. After several weeks those calves that were separated when injected with tuberculin showed no reaction, while ten per cent. of calves not separated showed the reaction during the first year of life.

Numerous other statistics might be cited to show the prevalence of this disease in different portions of the world, but a sufficient number are here quoted to show that it has a strong foothold among neat stock everywhere, and that it is apparently gaining ground.

In the report, made in 1895, of the Royal Commission of Great Britain, to inquire into the effect of food derived from tuberculous animals on human health, after citing the above statistics relating to the Copenhagen and Berlin slaughter houses, we find the following: —

> There do not exist for the United Kingdom any records with which these can be compared. At Copenhagen and Berlin all the meat furnished to the towns is submitted to the inspection of experts. But we have reason to think that the facts about tuberculous animals would exhibit a broad resemblance to the foregoing if such records could be obtained; not more different in degree, that is, than the difference seen between the Copenhagen and Berlin records, or than would be explained by variations in the practice of dealing with food animals in one and another country. Such few data as are to be had for the United Kingdom confirm this view. Three hundred milch cows had to be slaughtered in Edinburgh in 1890 on account of the appearance of epidemic pleuro-pneumonia there, and their carcasses were examined as to the presence or absence of tuberculous matter in them. Of the 300, 120, or 40 per cent., were found to be tuberculous, the percentage varying between 12 and 83, according as they came from one or another cow house. In Edinburgh, again, out of 27,769 cattle bought for slaughter at the public abattoir in 1890, 179, or .65 per cent., were condemned as being tuberculous, this percentage having risen from .16 in 1887, when the system of examining for tubercle was begun there. Five pigs were condemned in 1890, out of 4,973, and no calves out of 5,160; no record is given about sheep.

THE USE OF MILK AND MEAT COMING FROM TUBERCULOUS ANIMALS.

In the report of this Board for 1894 there will be found on pages 31 to 37 a discussion of the dangers to the public health through the use as food of the flesh and milk of tuberculous animals; and numerous statistics are there cited, tending to show that the use of these products is attended with a considerable amount of danger. While there may be a considerable difference of opinion as to the actual extent of the danger, or as to whether the disease in any particular case can be proved to be directly traceable to the consumption of these products, the general consensus of opinion among those best qualified to judge of the matter is that milk and meat derived from tuberculous animals should not be used as human food. In addition to the statistics in this connection, cited in the report of last year, we desire to call the attention of your honorable body to the following quoted opinions, all of which have been received since the date of our last report.

In a set of resolutions passed on Sept. 12, 1895, by the United States Veterinary Medical Association, in the convention held at Des Moines, Ia., the following occurs: —

> *Whereas*, Tuberculosis is an infectious disease, dangerous alike to man and the lower animals; and
>
> *Whereas*, Scientific experimentation has demonstrated the possibility of transmitting the disease through dairy and other animal products from tuberculous animals; and
>
> *Whereas*, The extensive use of tuberculin as a diagnostic agent has thoroughly demonstrated its high value for that purpose; therefore, be it
>
> *Resolved*, That it is the judgment of the United States Veterinary Medical Association that it is the duty of sanitary boards and other health officers to employ all practical methods calculated to restrict this disease.
>
> *Resolved*, That we regard the tuberculin test as the only reliable means now known to the scientific world for detecting obscure cases of tuberculosis in the living subject, and that it is a reliable test when performed under proper and well-known necessary conditions. It is further —
>
> *Resolved*, That reliance upon the physical examination of animals for the existence of tuberculosis is unwise, deceitful and unwarranted in the present day.

In the last International Veterinary Congress, held at Berne, Switzerland, in September, 1895, the following conclusion was reached and promulgated as being the opinion of the Congress: —

> The flesh of tuberculous animals, if sold, should be subject to special regulations.
>
> A part of this flesh must be destroyed, but some of it may be safely used for food.
>
> The milk from cows with tuberculous udders is extremely dangerous.

The milk from tuberculous cows with apparently healthy udders may be dangerous, and is always suspicious.

In the year book issued by the United States Department of Agriculture for the year 1894 the following occurs : —

The dilemma in which the demands of public health have put the owner of cattle, as well as the health officer, has already been stated. The following statements referring to this subject are based upon a careful study of the distribution of the disease in a large number of animals. It needs to be emphasized here that arguments deduced from the superficial examination of a carcass and the simple determination of the presence or absence of tuberculosis are worth little or nothing in attempting to solve the problems presented by the sanitary side. Only a thorough survey of the entire distribution of the tuberculous deposits in animals furnishes us with approximately correct data.

The flesh of those infected cattle in which the disease is restricted to one or two primary foci must be regarded as entirely harmless and of full nutritive value. Even in advanced cases, which should always be rejected, the glands embedded in the muscular tissue are found infected only occasionally.

The condition of the milk in different stages of the disease is a question of much greater importance, and demands the most careful consideration. We may, for convenience and clearness, typify three stages : —

1. In the earlier stages of the disease, provided the udder is normal, the milk is free from tubercle bacilli.

2. In the more advanced stages, provided the udder is normal, the milk may or may not contain tubercle bacilli. If the disease has become generalized, the indications are that at some time or other tubercle bacilli may pass into the milk. This passage is revealed at the autopsy by disease of the glands or the udder. The indications are that this passage is largely temporary, perhaps lasting only a day before the tubercle bacilli are caught up and filtered out into the lymphatic system. The indications are, furthermore, that comparatively few bacilli pass through the udder. The udder itself does not favor their development there, and the closest inspection fails to reveal any augmenting foci of disease. These statements are based upon careful examination of slaughtered cattle and the thorough testing of the milk from advanced cases.

3. When the udder is affected in any stage of the disease, a most grave condition is presented. Tuberculosis of the udder in most

cases comes on in the later stages, when the virus is distributed by the blood from some disintegrated earlier focus of disease. Primary tuberculosis of the udder, that is, infection from without, has not yet been established definitely, and is probably of very rare occurrence. When the disease has started in the udder itself, tubercle bacilli may be discharged in the milk in large numbers and for long periods of time. The smaller the herd, in such a case, the more dangerous the entire milk becomes, because of the concentration of the virus.

Udder tuberculosis is thus a most serious danger, the importance of which cannot be too strongly urged. Fortunately, it is rare. The writer has encountered, among two hundred infected animals, only one case of udder disease, and sixteen others which, according to the post-mortem studies, may have shed at one time or another tubercle bacilli into the milk in small numbers, but which had no recognizable disease of the udder itself. The large percentage of udder tuberculosis reported by several writers lately is incompatible with all former statistics, and indicates either an unprecedented condition in certain localities or else an error in diagnosis. The stock owner, in the absence of proper dairy or other official inspection, is under serious moral responsibilities to remove from his herd those animals in which there is even a suspicion of udder tuberculosis. Any udder which is found to increase slowly in size without any indication of inflammatory processes, recognizable by the presence of heat, pain and redness, and which becomes very firm without showing at first any alteration in the appearance of the milk, should be regarded as infected, the cow promptly segregated, and the entire milk rejected until a diagnosis can be made by a veterinarian.

In view of the fact that tuberculin does not discriminate between dangerous and harmless cases, the public health problem as it presents itself in practice is simply this: what shall be done with all the cattle which give the tuberculin reaction, in order that we may catch and destroy the ten per cent. of slightly and temporarily dangerous cases among them, or the one per cent. of serious cases? Some of the dangerous cases are so far along in the disease that they are easily detected without the aid of tuberculin, but this is by no means true of the majority. The situation certainly demands a most rigid periodical inspection of all animals furnishing milk to consumers, the prompt removal of all suspicious cases, and, above all, a more thorough control of the dairy in the interest of public sanitation.

In 1890 a Royal Commission was appointed by the government of Great Britain, "to inquire and report what is the effect, if any, of food derived from tuberculous animals on human health, and, if prejudicial, what are the circumstances and conditions with regard to the tuberculosis in the animal which produce that effect upon man?"

This commission, after nearly five years of consideration and investigation of this subject, at an expense of more than $90,000, reported on April 10, 1895, and from this report we quote the following: —

> The primary object of the commission, to learn the "effect of food derived from tuberculous animals upon human health," was obviously one that could not be attained by direct experiment upon human beings. Yet it was upon this question that there had been least accord among the witnesses, though they did agree in their assurances that there was no valid evidence on the point to be had. The commission undertook, therefore, these inquiries as to the effect of tuberculous food upon the health of lower animals, in the expectation of obtaining information applicable to the case of a human subject.
>
> Dr. Martin selected for his experimental research a variety of animals which differed in their customary food material: pigs, guinea-pigs and rabbits. The animals were fed with their usual food, with the addition of some material (sometimes meat, — much in the sense that a butcher might speak of meat, — sometimes milk, but always uncooked) derived from a tuberculous animal. No particular examination for actual tubercle in the food material was made in the experiments now being recorded, but some care was taken to avoid any obvious mass of tubercle.
>
> Of each kind of animal thus fed, a certain percentage was found to become tuberculous: of pigs, 36 per cent. (5 out of 14); of guinea-pigs, 16 per cent. (24 out of 145); of rabbits, 15 per cent. (2 out of 13).
>
> The experiment comprised also a number of animals kept under the same conditions as the rest (the pigs being members of the same litter), and only differing from the other animals of the experiment by receiving no material from a tuberculous animal in their food. Of these "control" animals (numbering 5 pigs, 203 guinea-pigs and 8 rabbits), none became tuberculous.
>
> We cannot but regard these differential experiments as showing a danger to a healthy animal from the introduction into its food of material taken from a tuberculous animal.
>
> Further, Dr. Martin made experiments, not only with feeding material "derived from tuberculous animals," but with material containing tuberculous matter, recognized as such, and purposely

added to the food of the experimental animal. This was done in the case of 1 pig, 8 guinea-pigs and 10 calves; and of these, the pig, 6 guinea-pigs and 8 calves became tuberculous. In these experiments the tuberculous matter had been taken sometimes from a bovine, sometimes from a human source, and it is noteworthy that each animal received only a single dose of it.

Other experiments with manifestly tuberculous matter are recorded by Dr. Woodhead among a number of investigations made in the course of his own inquiry undertaken for us. He found this matter, given (uncooked) to various animals, gave rise to tuberculous disease in all the pigs (7) and all the cats (5) that received it, and in 50 guinea-pigs out of 76.

These more particular experiments by Drs. Martin and Woodhead, made with matter that had been identified as tuberculous, add much force to the inference derived from Dr. Martin's more general experience. They indicate, in the material used in feeding, the element that is dangerous to the healthy animals which have been fed.

We cannot refuse to apply, and we do not hesitate to apply, to the case of the human subject the evidence thus obtained from a variety of animals that differ widely in their habits of feeding, — herbivora, carnivora, omnivora. As regards man, we must believe — and here we find ourselves agreeing with the majority of those who gave evidence before us — that any person who takes tuberculous matter into the body as food incurs some risk of acquiring tuberculous disease. By "tuberculous matter" we mean here, of course, that which is capable of giving rise to tuberculosis in lower animals. This matter may be found in parts of animals affected by the disease. It is known to the naked eye by some well-marked though various characters, and microscopically by the all but certain discovery of characteristic bacilli, — the bacilli of tubercle.

It is this same matter, however, — known by naked-eye characters that are very closely the same in man and in animals, and by microscopical characters that are all but identical, — that gives rise to tuberculosis in the human subject. And we find the present to be a convenient occasion for stating explicitly that we regard the disease as being the same disease in man and in the food animals, no matter though there are differences in the one and the other in their manifestations of the disease; and that we consider the bacilli of tubercle to form an integral part of the disease in each, and (whatever be its origin) to be transmissible from man to animals and from animals to animals. Of such transmissions there exists a quantity of evidence, altogether conclusive, derived from experiment. It is with the transmission of the disease to man by the ingestion of animal food that the present commission is concerned.

The results of their entire inquiry into this matter are summed up by the Royal Commission as follows: —

> We have obtained ample evidence that food derived from tuberculous animals can produce tuberculosis in healthy animals. The proportion of animals contracting tuberculosis after experimental use of such food is different in one and another class of animals; both carnivora and herbivora are susceptible, and the proportion is high in pigs. In the absence of direct experiments on human subjects, we infer that man also can acquire tuberculosis by feeding upon materials derived from tuberculous food animals.
>
> The actual amount of tuberculous disease among certain classes of food animals is so large as to afford to man frequent occasions for contracting tuberculous disease through his food. As to the proportion of tuberculosis acquired by man through his food or through other means we can form no definite opinion, but we think it probable that an appreciable part of the tuberculosis that affects man is obtained through his food.
>
> The circumstances and conditions with regard to tuberculosis in the food animal which lead to the production of tuberculosis in man are, ultimately, the presence of active tuberculous matter in the food taken from the animal and consumed by the man in a raw or insufficiently cooked state.
>
> Tuberculous disease is observed most frequently in cattle and in swine. It is found far more frequently in cattle (full grown) than in calves, and with much greater frequency in cows kept in town cow houses than in cattle bred for the express purpose of slaughter. Tuberculous matter is but seldom found in the meat substance of the carcass; it is principally found in the organs, membranes and glands. There is reason to believe that tuberculous matter, when present in meat sold to the public, is more commonly due to the contamination of the surface of the meat with material derived from other diseased parts than to disease of the meat itself. The same matter is found in the milk of cows when the udder has become invaded by tuberculous disease, and seldom or never when the udder is not diseased. Tuberculous matter in milk is exceptionally active in its operation upon animals fed either with the milk or with dairy produce derived from it. No doubt the largest part of the tuberculosis which man obtains through his food is by means of milk containing tuberculous matter.

The recognition of tuberculous disease during the life of an animal is not wholly unattended with difficulty. Happily, however, it can, in most cases, be detected with certainty in the udders of milch cows.

Provided every part that is the seat of tuberculous matter be avoided and destroyed, and provided care be taken to save from contamination by such matter the actual meat substance of a tuberculous animal, a great deal of meat from animals affected by tuberculosis may be eaten without risk to the consumer.

Ordinary processes of cooking applied to meat which has become contaminated on its surface are probably sufficient to destroy the harmful quality. They would not avail to render wholesome any piece of meat that contained tuberculous matter in its deeper parts. In regard to milk, we are aware of the preference by English people for drinking cows' milk raw, a practice attended by danger, on account of possible contamination by pathogenic organisms. The boiling of milk, even for a moment, would probably be sufficient to remove the very dangerous quality of tuberculous milk.

In a bulletin very recently issued from the experiment station of the Agricultural College of Iowa the following statements are made as a result of investigations conducted by several scientists: —

> Milk from tuberculous cows may convey disease to the consumer.
>
> Milk from tuberculous cows having non-affected udders may convey the disease.

At a meeting of the Association of New England Cattle Commissions, held at Providence in September last, many instances were related by the members present of cases which have come to their personal knowledge, wherein, undoubtedly, disease had been communicated to people partaking of the milk of diseased animals. Several delegates related instances where members of their own family had died of tuberculosis, contracted, in their opinion, from the use of the milk of tuberculous cows. It is to be regretted that the statements made at this meeting cannot be more fully given; but, as no shorthand reporter was present, a full report was not made; but the evidence as appealing to those present at the meeting was, to say the least, startling.

Upon this subject Dr. F. H. Rich of the Burlington, Vt., Experiment Station, read a very interesting paper upon the relations between bovine and human tuberculosis, in which, among other things, he stated that bovine tuberculosis was of comparatively recent date in this country, and was undoubtedly imported. It is undoubtedly infectious, and easily transmitted by tissue or milk to other animals. Where an infected herd is found, the young stock and hogs are often found infected by the milk. There are two kinds of the disease in both bovines and man, — acute and chronic. The symptoms are much the same in both humans and bovines, although, while in man it causes emaciation, the bovines are usually as sleek and fat as ever. The bovines retain their appetite, while the humans lose theirs. He gave several instances where the owners of herds found to be infected with tuberculosis had died with pulmonary tuberculosis, evidently taken from the milk of the animals. Other instances were given where the pricking of a finger on a piece of bone from an infected animal had caused tubercular meningitis. All the standard medical works recognize the use of tuberculous meat and milk, especially the latter, as a potent cause of tuberculosis in man. For this reason the boiling of milk is usually advisable.

Among the various forms of human tuberculosis we have the acute general miliary form, resembling the acute fevers, usually terminating fatally in a few weeks. Then we have several types affecting the lungs more particularly, acute and chronic miliary tuberculosis of the lungs, and acute and chronic tubercular phthisis. Tubercular lymphatic glands are very common, particularly in children. Tubercular meningitis is also becoming quite common in children, while tuberculosis of the intestines and mesenteric lymphatic glands accounts for a large proportion of the deaths of children, particularly in our large cities, from so-called bowel difficulties. The tuberculous affections of the skin are lupus, scrofuloderma and anatomical tubercule. Rectal fistula and much of the so-called chronic diarrhœa are now considered to be of tubercular origin. Tuberculosis of the joints and bones is very common indeed, familiar examples of which are hip-joint diseases, white swelling of the knee and Pott's disease of the spine.

Mortality statistics show that fourteen per cent. of all deaths result from tuberculosis. The human system is equally if not more susceptible to the invasion of this infection than that of any of the lower animals. Milk is more to be dreaded than meat, because it is taken raw, and the udder is so often the seat of tuberculosis. Even in the absence of tuberculosis of the udder, the milk is sometimes infectious. It is routine practice to place patients upon milk diet during the course of and convalescence from nearly all acute diseases, when, by reason of lowered vitality, they are temporarily predisposed to tuberculosis, thus combining the most favorable conditions for the implantation of the active germ. This fact seems to offer practical explanation of the frequent supervention of tuberculosis upon other diseases.

Tuberculous meat is not liable to infect, if it is thoroughly cooked, because of the sterilizing effect of heat; but the interior of rare steaks and roasts are not sufficiently heated to destroy the tubercule bacilli occurring in the several lymphatic glands included, and in tuberculous pork the bacilli are even found in the muscle proper. The livers of both cattle and hogs, so commonly eaten, are tuberculous in a very large number of cases.

While there is a pretence at inspection in our great packing centres, there is little if any elsewhere in this country. Our home-dressed beef consists principally of old, worn-out cows, an alarmingly large percentage of which are tuberculous. The hind quarters will usually pass detection, which, together with such fore quarters as can be trimmed up and made passable, are sold in our markets. Some parts that will not bear passing scrutiny in the market are converted into corned beef, sausage, or are canned; while such as are too far gone for this are, together with all diseased viscera and other slaughter-house refuse, fed to a drove of hogs kept for that purpose, which in turn contract tuberculosis, are slaughtered and sold in our markets, and thus little of the infection fails to reach some home. The importance of the subject is shown by the mortality statistics, from which it is seen that three million human beings die of the disease every year.

At the close of the meeting the members present passed the following resolution: —

Resolved, That the members of this association are of the opinion, which is based upon personal knowledge and observation, that there can be no doubt that tuberculosis is frequently transmitted from cattle to the human family; and we therefore recommend the enactment of laws that will suppress this dangerous disease among cattle.

At a meeting of the Suffolk District Medical Society, a division of the Massachusetts Medical Society, held on April 27, 1895, the following resolve was unanimously adopted: —

Resolved, That the existence of tuberculosis among neat cattle within this Commonwealth is a menace to the public health, as we believe that bovine and human tuberculosis are identical, — that is, that they are caused by the same germ, and that it is possible for the disease to be transmitted from the lower animals to man by the use of milk or meat from diseased animals. We shall heartily endorse any methods that may be undertaken by the State which will include a careful and thorough examination of all animals from which milk supply is obtained, and which shall also keep a close supervision over the meat products coming from slaughter houses within the Commonwealth.

Circumstances determining Danger to Man from Meat and Milk of Tuberculous Organs.

In regard to the danger from the use of meat, we quote further from the report of the Royal Commission: —

We regard it, then, as established that any person who takes tuberculous matter into the body as food incurs risk of acquiring tuberculous disease; and we know that this matter may be found in parts of animals affected by the disease. It is therefore of the first importance to us to note what parts of a tuberculous animal are liable to contain this tuberculous matter, having well-marked characters of its own, and among them the bacilli, which form an integral part of the disease. From this view point we would report separately upon meat and milk derived from these animals, and begin our consideration with meat.

We find it necessary, in our study of the "circumstances and conditions, with regard to tuberculosis in the animal," which endanger human health, to include in our definition of meat the various parts of the tuberculous food animal, and to assume a certain acquaintance with the actual presence of tubercle in the several parts. When, on the other hand, we wish to speak of the customary "joint" of the butcher, and to exclude organs and other tissues, we refer to it as *meat substance.* We do not propose to consider, except incidentally, carcasses from which the organs have been removed in such wise that the condition of them could not be known to us.

We have now to point out the very great difference in one and another part of a tuberculous animal in the amount of tuberculous matter contained in the meat. This matter is found principally in the organs of the animals; as a rule, most abundantly in the lungs, lymphatic glands, serous membranes, but often in the liver, spleen, kidneys, intestines and other structures. These organs are usually removed by the butcher in "dressing" the carcass, though some of them may, intentionally or not, be left. To a practised eye it is hardly possible that tuberculous matter in these organs can escape detection, and the importance of its presence there will soon be apparent; for in the tissues which go to form the butcher's "joint" the material of tubercle is not often found, even where the organs exhibit very advanced or generalized tuberculosis; indeed, in muscle and muscle juice it is very seldom that tubercle bacilli are to be met with; perhaps they are somewhat more often to be discovered in bone, or in some small lymphatic gland imbedded in intermuscular fat. Yet there is always a difficulty in making sure of the absence of tuberculous matter from any part of a carcass that shows evidence of tubercle elsewhere.

In Dr. Martin's experiments for the detection of tuberculous matter three kinds of test were employed; first, minute examination of the part for tubercle, with the aid of the microscope, to discover tubercle bacilli; secondly, feeding susceptible animals — test animals — with suspected matter; and, thirdly, introducing into the bodies of test animals some of the suspected matter by way of inoculation, — a more delicate test than the process of feeding.

Applying these tests to the meat substance of twenty-one cows known to be tuberculous in one or another degree, he could not get visible evidence of tubercle except in two instances, and there it was of very small amount. He records the results of his other tests as follows: "Of eight cows (mild tuberculosis), the meat of one gave positive results in one animal from inoculation, none by feeding. Of eight cows (moderate tuberculosis), the meat of three gave positive results in four animals from inoculation, none by feeding. Of five cows (generalized tuberculosis), four gave positive results either by inoculation or by feeding," one only out of the four appearing to answer to both tests.

The animals which had yielded affirmative results to his test of minute examination were not among the last five; they were in the group of cows with "moderate tuberculosis," and had given no result by feeding test animals with meat from their carcasses, though meat from one of the two had, upon inoculation, responded to the test.

These were not the results to be expected from Dr. Martin's experiments, if he were really using muscular tissue (with its usual concomitants, forming "meat substance") containing or not containing tuberculous matter among the fibres. He would not have expected to find himself repeatedly giving rise to tuberculous disease by the use of material in which no tubercle could be detected by his ocular tests. He might have expected, on the other hand, a more uniform affirmative result when he was experimenting with the two cows whose meat had shown to his eye and his microscope evidence of tuberculous matter; though he might have explained a failure to get such results by the small amount of tubercle discovered there. And certainly he did not expect to get, if he was using only such tuberculous material as was present in the muscular tissue of his twenty-one cows, the egregious irregularities which he observed in his feeding and inoculation experiments. He was dealing with a quantity of tuberculous matter supplied to him, not, he reasoned, from the muscular tissues that he had proposed to investigate, but somehow from the general carcass of the cow, and abundant in the matters he was inoculating just as it happened to be abundant in the general carcass, and insufficient in amount, until he came to the maximum amount in the general carcass, to react to the test of feeding, though (with smaller amounts in the carcass) he had sometimes got an answer to the more delicate test of inoculation.

Dr. Martin tried in vain to explain these unexpected results by a hypothesis that he had overlooked some minute tubercles in the small portions of meat that had been used by him in his feeding and inoculation experiments. Even this hypothesis would not account for all the observed facts. And he presently saw another consideration, of a different nature, which he might not have sufficiently taken into his account, — the operations, namely, of the slaughterer and butcher.

Dr. Martin was not, at this stage of his researches, experimenting broadly about things in general taken from the carcass of an animal after slaughter, but he was trying to learn the distribution of tubercle in the body of the animal, in the hope of adding to our knowledge of the conditions which might give to meat the quality of injuring the consumer of the meat. Still, he was dealing with meat, as meat would be sold by the butcher. He had already sought, by discriminating between "trimmed" and "untrimmed" meat, to estimate the risk of including in his own specimens of meat the stuff which, for little else than for the sake of tidiness, the butcher removes in preparing his joint for sale, and that consists *inter alia* of bits of gland and serous membranes. But, though he had been at some pains to secure that this trimming was done with efficiency, there proved to be no constant line between the trimmed and the untrimmed meat in its effects upon test animals.

He now came to see a real and considerable danger to the meat, of the same nature as that which he had previously sought to estimate when he was careful about the trimming of meat, — a danger that was somewhat less obvious, but would be quite as real. This was, the probability of the meat becoming contaminated from the actual tuberculous lesions, present in other parts of the carcass, and conveyed from thence to the proper meat substance by the hands, knives and cloths of the butcher, during the processes of flaying and dressing. This was a danger that would doubtless increase along with increased abundance of the material of tubercle in the carcass. "The greater the amount of tubercle there is in the cow, the more likely is the sticky caseous matter to get smeared over the carcass;" and much that was inexplicable in the results of feeding and inoculation of test animals would be rendered intelligble.

Dr. Martin writes: "If we imagine that the meat gets contaminated accidentally in this way, it is easy to explain the irregularity of the results: (1) how, for example, in cases of mild tuberculosis of the cow, the danger of contamination is not great, and therefore the meat does not get smeared to any extent during removal, so that no positive results were obtained by feeding, and only one positive result by inoculation, and this a case of local tuberculosis, showing a small dose; (2) how, in cases of moderate tuberculosis, where chiefly the lungs and lymphatic glands in the thorax are affected (and so may be removed entire without incision of a tuberculous lesion), the meat, as in cases of mild tuberculosis, would not become much contaminated, and thus did not produce tuberculosis by feeding; and how in these cases the knife is more likely accidently to incise a tuberculous lesion than in cases of mild tuberculosis, and that therefore the number of cases of positive inoculation is greater. . . . With generalized tuberculosis of the cow this danger would increase, since so many parts of the body are affected with the disease, so that in such cases we meet for the first time with positive results from feeding, but not uniformly positive . . .

"Taking all the results together, the method of removal of the meat, the results of inoculation and of feeding, one is driven to the conclusion that when meat is infective it commonly acquired its properties by being accidentally contaminated with tuberculous material during its removal from the carcass. This conclusion, it is evident, is one of great practical importance, bearing directly on the question of the condemnation of the meat of tuberculous cattle for human consumption. And it is evident, also, that the infective properties of meat might vary with different series of experiments; . . . the result depends on the care taken in guarding against contamination more than on anything else. The conclusion arrived at in part explains the extremely divergent results obtained by previous observers."

The observations by Dr. Martin cannot altogether dispose of this hypothesis, that the unexpected affirmative results obtained by his feeding and inoculating experiments may have been due to the presence of unobserved tuberculous matter in the meat substance, possibly in the actual muscular tissue; but they certainly show another and more obvious way in which these results may have been brought about. To have demonstrated this extrinsic way of rendering dangerous the meat substance of tuberculous animals, is to destroy all evidence that might otherwise have been obtained respecting the wholesomeness or unwholesomeness of the proper meat substance towards his test animals.

We note, in passing, that this method of endangering the meat substance could not have been detected upon carcasses from which the organs, together with any "grapy" deposit, had been removed. And it is pertinent to observe, in connection with a contamination so effected, that this extrinsic danger to harmless meat (or to meat that was, for all that is shown to the contrary, harmless) might just as well be encountered by meat from another animal (whether pig, sheep, or calf, ox or cow) that was perfectly free from tubercle, but only had happened to be the next animal brought to the same slaughterer.

Having regard to Dr. Martin's invariable failure to produce tubercular disease by feeding (though he sometimes did succeed by inoculating) test animals with the meat taken by him from cows with mild or moderate tuberculosis, and admitting his explanation of an affirmative result, sometimes seen when meat was being taken from cattle with advanced or generalized tubercle, we are prepared to believe with him that, if sufficient discrimination and care were exercised in taking meat from tuberculous cattle, a great deal of meat from them might, without danger, be consumed by the community. The practice of public abattoirs on the continent appears to be founded on the same belief.

Dr. Martin, having shown that tuberculous material may be thus distributed through the carcass of an animal, and regarding the disease as being at its early stages a local disease, and its material as being in the first instance limited to the neighborhood of the place at which it had originally entered the body, is ready to formulate certain precautions that could be taken for reducing to a minimum, so far as present knowledge extends, the danger to human consumers of meat by their partaking of tuberculous meat. He would advocate, as a principle, that the operations of slaughter and dressing should be done under skilled supervision, with the object of securing the removal and destruction of every part of a carcass that contained any tubercle whatever, and also the destruction of the whole carcass in cases where the animal was found to have advanced or generalized tuberculosis. He indicates, for the assistance of any meat inspector, various evidences of the disease having reached that more serious stage. For the rest, Dr. Martin sees no objection to the sale of meat substance from carcasses which have shown only localized tuberculosis, and from which every particle of tubercle has been skilfully removed; provided always, that, in every subsequent process of preparing the meat for sale, due care be taken to guard the salable portions from contamination by tuberculous matter.

Reporting up n his twenty-one tuberculous cows from his present stand-point, Dr. Martin tells us that, if his ideal precautions had been in force, the meat of nine cows would have been condemned, and the meat of the other twelve might have been sold.

It is hardly necessary to point out that little evidence about the more serious degrees of tuberculosis in the animal would be discoverable in carcasses from which the organs had been removed; and that this is habitually the case with so-called "dead meat," whether English or foreign. Still, there are indications in such a carcass, to the eye of an experienced inspector, of the more dangerous forms of tuberculosis having existed in the animal.

Dr. Martin's suggestions are, in our judgment, based on well-ascertained pathological facts. We have no doubt that the supervision which he recommends would tend, in an important measure, to the security of the public. But we are well aware that the difficulties of such supervision are so great that many years must elapse before any measure of an effectual kind can be carried into practice.

In the mean time, we venture to express our confidence that the precise information which has now been gained as to the nature, extent and limitation of the risks which arise from the consuming of the meat of tuberculous animals may be of value to those who have concern with our meat supplies, in guiding them to the adoption of such precautions as may, under present conditions, lie within their power.

Some very careful experiments, to ascertain the influence of cooking upon meat, were made by the Royal Commission, and of it they have the following to say: —

> In the boiling and roasting experiments, as ordinarily carried out in the kitchen, the temperature, however high it may be near the surface, seldom reaches 140° F. in the centre of a joint, except in the case of joints under six pounds in weight. Ordinary cooking is quite sufficient to destroy any smeared material that remains on the outer surface of the meat. *But it cannot be relied upon in the slightest degree to render inoculous the same* smeared material when in the centre of a roll. . . . Ordinary cooking, such as boiling, and more especially roasting, though sufficient to sterilize the surface and even the substance for a short distance from the surface of the joint, cannot be relied upon to sterilize tubercular material included in the centre of rolls of meat, especially when these are more than three or four pounds in weight. The least reliable method of cooking for this purpose is roasting before the fire, next comes roasting in an oven, and then boiling.

Regarding the dangers coming through the use of milk from diseased animals the evidence is much greater, and facts are much more easily procurable. In this connection we again quote from the report of the Royal British Commission: —

> According to our experience, then, the condition required for insuring to the milk of tuberculous cows the ability to produce tuberculosis in the consumers of their milk is *tuberculous disease of the cow, affecting the udder.* It should be noted that this affection of the udder is not peculiar to tuberculosis in an advanced stage, but may be found also in mild cases.
>
> Further, with reference to this disease, Dr. Martin writes: "The milk of cows with tuberculosis of the udder possesses a virulence which can only be described as extraordinary. All the animals inoculated showed tuberculosis in its most rapid form." Dr. Woodhead, investigating, for his own purposes, the effects of unboiled milk, speaks in similar terms of this virulence of milk derived from tuberculous udders and inoculated into test animals. The two observers had occasion to use milk from a cow that had tuberculous disease in one-quarter only of the udder, and they found the milk from the other three-quarters to be perfectly harmless on inoculation; but the mixed milk taken from the four teats was to all appearance just as virulent as the milk from the diseased quarter. Butter, skim-milk,

buttermilk, obtained from the milk of a cow having tuberculous udder (by the usual processes, but with complete precautions against accidental contamination of articles used in the manufacture), all contained tuberculous matter actively injurious to test animals.

And not only this virulence, but the rapidity with which milk can obtain its harmful quality, attracted Dr. Woodhead's attention. He reports: "A most important point is that the spread of tubercle in the udder goes on with most alarming rapidity, — this I was able to observe in the cows constantly under observation; but I have also noticed on several occasions, during the interval between fortnightly inspections carried on along with a veterinary surgeon, that the disease has become distinctly developed. It may be, of course, that the early evidence has been overlooked at the previous inspection; but, whether this is the case or not, the spread of the disease was so rapid as to afford very good ground for alarm. The very absence of any definite sign in the earlier stage is one of the greatest dangers of this condition." And both Dr. Martin and Dr. Woodhead insist that no tuberculous animal of any kind should be allowed to remain in a dairy.

The withdrawal from dairies of every cow that had any disease whatever of her udder would form some approach to security against the serious danger incurred by man from the use of tuberculous milk, but it would not be an adequate security. The presence in a dairy of a tuberculous cow, as Drs. Martin and Woodhead have shown, is a decided source of danger to the public, especially having regard to what we have learned respecting the rapid development of tuberculosis in the udder, and the degree of danger to milk consumers incurred by the invasion of the udder in tuberculous cows.

It follows, from the observations here recorded, that it is of supreme importance to the consumers of milk that the existence of any tuberculous disease of the udder should be ascertained without delay. Now, there is no difficulty whatever about recognizing the presence of *some* abnormal condition in a cow's udder, and the presence of such condition — whatever it be — demands that the judgment of a responsible expert should forthwith be obtained about its nature, — unless, indeed, the owner prefers to slaughter the cow without delay. If the expert finds tubercle bacilli in the milk, the cow has dangerous tuberculosis of the udder. If he does not find them, he may apply the further test of inoculating some susceptible animals with the milk, and thereby learn the nature of the udder disease. By this test he will very rarely be misled. Obviously the cow must be in seclusion, and every particle of her milk must be treated as highly dangerous, during any delay that can be permitted for diagnostic purposes, and until the disease has been proved not to be tuberculosis.

In considering this part of the report, one is at once struck with the hesitancy with which the commission recommend the use of milk from tuberculous cattle, even although the animals do not show apparent udder lesions; and the question for us at once arises, as to whether or not it is practicable, in dealing with this matter on so large a scale, to draw any line whatever as to the location of the disease; that is to say, even with this testimony in view, is it not far better and safer to at once destroy the cow, when it has become clear beyond doubt that she is the victim of tuberculosis?

As to the influence of the cooking process upon tubercular milk we have the following, from the report of the Royal Commission: —

> Sterilization towards tubercle can be effected by heating the milk in a water bath, continuing the process until the temperature has risen from 176° F. to 198° F., — a result which in most cases requires each several quart of milk to be in the water bath for some half hour.
>
> Dr. Woodhead has not wholly demonstrated to our satisfaction the innocence of tuberculous milk treated in this manner; he tells us of pigs succumbing to tuberculosis after feeding with tuberculous milk heated to 176° F. for ten minutes, without giving adequate data about the action or inaction of the milk after longer exposure to this temperature; and his experience of the higher temperature is derived from guinea-pigs only, not from pigs; though, as he has shown, guinea-pigs do not supply such good evidence as pigs about the influence of heat upon tuberculous matter in use as food.

In speaking further of these experiments made by Dr. Woodhead, the Royal Commission say: —

> Nor, if we regarded the described method as certain in its efficiency, should we hesitate to refer to any such "sterilization" the simple expedient of putting every suspected milk over the fire and taking it off when it boils.

A very interesting statement of this report is as follows: —

> In the course of Dr. Woodhead's observations on the degrees of heat wanted to destroy the operation of tuberculous matter in milk,

he noted the effects upon tuberculous material resulting from temperatures insufficient for its actual destruction. He could, by the operation of certain lower temperatures, obtain from "the most deadly tuberculous material" contained in milk a weaker sort of tuberculous matter, so tardy in its operation on test animals as to simulate the slower forms of consumption seen in the human subject; or, when used to feed pigs, — animals having some specialties of throat structure like that of man, — gave rise to chronic enlargements of the throat glands, resembling the scrofulous glands so common in children. These observations are of much interest to us, not least because they suggest the possibility of widely prevalent forms of human tuberculosis owning an origin in milk.

In the eighth annual report of the Vermont Agricultural Experiment Station, recently published, upon page 54 we find the following: —

> It is obvious that direct experiment on man with tuberculous material from the lower animals is out of the question. There are on record, however, a number of cases of accidental infection of human beings by the products of tuberculous cattle. There is reason to believe that countless thousands of deaths have occurred due to this source of infection, which have not been thus ascribed and of which no record has been made. Children are more likely to be infected than adults, owing to their tissues being less resistant, and because their chief food is milk. It should not be inferred, however, that disease and death of necessity follow the consumption of tuberculous meat or milk.

Following this will be found, upon pages 54, 55, 56 and 57 of the same report, a minute relation of a large number of cases, in which it seems clear that tuberculosis has been contracted by mankind from using as food the milk and meat coming from diseased animals.

USE OF TUBERCULIN.

It is generally agreed, as will be seen by the statements of leading authorities already quoted, that tuberculosis exists in a very large degree among neat stock; that the existence of such disease in these animals is a menace to a greater or less extent to the human race, through the danger of the transmission of the disease by the consumption of the meat and milk of such animals. And the important question is, What steps can be taken to remove or lessen the danger of the transmission of this disease through the medium of milk and meat?

Of course the danger from this source can be removed by ceasing to use the milk and meat product of such animals; but such a step is utterly impossible, as this forms such a large proportion of the food of the human race. If this product must continue to be used, the question would arise, Can it be so purified as to remove or destroy the contagious principle contained in it, or can steps be taken to prevent such product containing such contagious principle? To remove the contagious principle from the milk or meat before consumption is, as a whole, impracticable, as has already been shown in other portions of this report. Sterilization of milk as ordinarily conducted, and the cooking of beef in the manner that it is ordinarily done, are not sufficient to destroy the germ, although they may to a greater or less extent lessen the danger from this source. Inasmuch as it is impossible to know without special experimentation whether the milk or beef in each particular case contains the contagious principle, such a system, to be at all adequate, would require the sterilization of all of this product; there is no practical means of accomplishing this, even if it would result in the destruction of the germ, for the reason that the public at large, not realizing the importance of the work, would not take the necessary steps.

In the case of milk, the Royal Commission were of the opinion that nothing short of boiling would destroy the contagious principle; and it is a well-known fact that in boiling milk its constituents are so thoroughly changed that it is not as useful as a food, especially for infants, as that which has not been subjected to this great degree of heat. As a public sanitary measure, therefore, any system looking to the sterilization of the milk product, as a whole, would fall short of accomplishing the desired result. We must, therefore, either eliminate from the milk product that which is diseased, and destroy it, or we must see that the source from which the milk is derived is free from disease. It is impracticable, as a public sanitary measure, to eliminate the diseased milk and meat by means of any systematic examination of those products, as distinguished from the animal from which it is derived. The bacilli are so minute, and often widely scattered, that, even if these products could be submitted to microscopic examination, it would not result in the detection in all cases of the presence of the germ. The only other method of detecting the germ is by the inoculation of the lower animals, such as guinea-pigs, with the suspected meat or milk; but this is impracticable, for the reason that, before the result can be obtained, the meat or milk has long since ceased to be wholesome. We must, therefore, if any steps are to be taken, endeavor to prevent the contagious principle entering the meat or milk consumed by the public through the purification of it at the source of supply.

The milk and meat supply of this State comes to us from two sources,— that derived from animals located within the Commonwealth and that derived from animals without its borders. The commission has no statistics at its command from which it is able to determine the relative proportion of the product from these two sources. So far as the meat product is concerned, in the opinion of this commission and generally of those who have given the matter a special study, while the meat is a source of danger, it is not as important a source as the milk.

In the case of meat, a large proportion of that which comes from without the State comes from large slaughtering establishments which are under the supervision of the inspectors who work under the authority of the Bureau of Animal Industry of the United States Department of Agriculture;* and, so far as it is derived from within this State, it is made subject to examination by inspectors appointed by cities and towns; so that, regarding the product coming from our own licensed slaughter houses, it may be fairly well relied upon as being free from tuberculous taint.

It should be stated that slaughter houses still exist, in portions of the Commonwealth, which have failed to obtain the licenses provided by law, where this business is being conducted and the product disposed of in the market without being inspected. This evil is one that will become less and finally be corrected under the operation of the present law.

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* In this connection, a remark made by the Secretary of Agriculture, in his recent report to the President of the United States, is not without value for us. He says: "Meat and animal inspection must become of great sanitary value to consumers at home and to interstate and foreign commerce, provided State and municipal authorities intelligently and diligently co-operate with those of the national government. If such co-operation fails, then the people of the great killing centres become the consumers of all rejected animals and meats. The protection of domestic health will be much improved when each purchaser of meats demands and insists upon that which has been governmentally inspected and certified."

It is further possible that a certain small proportion of tuberculous meat may find its way into the market by reason of the animals not being inspected at the time of slaughter, because the owner had received a certificate of soundness of such animal, based upon physical examination, within six months prior to the slaughter; and, finally, in addition to this, there is undoubtedly a small amount of tuberculous meat now finding its way into our markets that comes from animals which have been killed just without our borders in the neighboring States.

The milk now being sold in Massachusetts is derived from home herds and from herds which are maintained outside the limits of the State, the product of which is regularly marketed in Massachusetts. Inasmuch as it is impracticable to see that the milk supply itself is pure except by purifying the animals from which it is derived, it follows that there is no practicable means whereby this State can assure the consumers that milk coming from without its limits is free from the contagious principle by any prescribed system of examination relating to the cows from which it is derived, because the Commonwealth has no jurisdiction over those animals. The only practicable method of overcoming this difficulty is to provide, in some form, that milk shall not be delivered in this State except that coming from animals which have been properly shown to be free from disease.

On Nov. 20, 1894, the Board, in its circular letter of that date, which will be found printed on page 186 of the report of that year, made the following declarations: —

> *First.* — That tuberculin is a reliable agent for determining the presence of tuberculosis in cattle.
>
> *Second.* — That tuberculin, properly prepared and carefully handled, can have no injurious effect upon healthy animals.
>
> *Third.* — That it is the only known means whereby a positive diagnosis can be made in the earlier stages of the disease.

This declaration was based upon the experience which members of the commission had had up to that time, covering many hundreds of tests. Since Nov. 20, 1894, this Board has made 26,958 tests, and, as a result, it is prepared to reaffirm every word and line contained in that declaration.

We have already shown in detail, in other portions of this report, the results obtained by the commission from the use of tuberculin the present year. This experience shows that it is a remarkably accurate agent when properly applied under well-known necessary conditions. There is no other known means of diagnosing bovine tuberculosis except what is known as the physical examination. Such an examination is utterly unreliable, and has been discarded by this commission as an ultimate test, as it has by all other commissions and scientific men working in this direction throughout the known world. The experience of the commission for the past year has shown that physical examination would have failed to detect the presence of the disease in the vast majority of the animals tested upon voluntary request; and, on the other hand, tuberculin showed that the disease was not present in more than 55½ per cent. of the animals which had been quarantined as suspicious upon a physical examination by the local inspectors. Such is the opinion of this Board, based upon its experience.

That a similar result has been reached by many others working in the same direction and with the same agent, the following extracts will show.

Resolution passed by the Association of Cattle Commissions of the New England States, July 25: —

> As a body, we heartily endorse and recommend the use of tuberculin as being the only reliable agent now known for the detection of tuberculosis in cattle. We also further believe that no harm whatever comes from its use in animals that are free from tuberculosis. No physical examination should be regarded as being reliable unless it has been accompanied by a properly made test with tuberculin. We further believe that no test should be made by other than practised competent persons, who will carefully follow all the known requirements for obtaining correct results.

At the annual meeting of the State Board of Agriculture, held at Dalton in December, the following recommendations were made: —

> *First.* — That, subsequent to June 1, 1896, the use of tuberculin as a diagnostic agent shall be applied to all herds in which one or more tuberculous animals have been found.
>
> *Second.* — All owners of herds in which one or more tuberculous animals have been found shall be required to make such reasonable changes in their stables and stable management as shall seem necessary to secure to their cattle the conditions known to be essential to health.
>
> *Third.* — Full compensation for an animal or animals found to be tuberculous upon any inspection subsequent to the first shall be allowed only when it shall appear that the owner has faithfully endeavored to carry out the changes which he has been desired to make.

In 1894 the State of New York appointed a special commission to investigate tuberculosis in cattle in that State, which commission made a report in the latter part of January, 1895, containing several recommendations as to the best method to be pursued in the eradication of that disease, all of which are based upon the tuberculin test.

In a report made by that commission, on Oct. 29, 1895, the following paragraph occurs: —

> The efficacy of tuberculin as a diagnostic agent is of incalculable benefit, although, if followed without due caution, in some cases it will lead to error. By the use of this agent some animals advanced in the disease fail to show any reaction, and in other cases animals not as extensively affected will show higher reaction. In the examinations thus far made not an error has occurred, as proven by the autopsies.
>
> There can be no doubt that the systematic inspection of milch cows and the killing of cattle undoubtedly affected will prevent a large loss to the dairymen and lead to a great saving of infant life.

Bulletin No. 29 of the Pennsylvania State College Experiment Station, issued in October, 1895, says: —

> All those who have used tuberculin in the United States for the diagnosis of bovine tuberculosis, and have published their work, including Drs. Law, Curtice, Conrow, Faust, Russell, Rice, Schroder, Niles, Eves and Pearson, have expressed themselves as extremely well pleased with the results with this agent.
>
> Remarkable to note, the occasional and scattered opposition to the use of tuberculin comes from those who have never employed it for the diagnosis in cattle.

In the Year Book of the United States Department of Agriculture for 1894, on page 324, occurs the following: —

The disease in the early stages can be detected only with the aid of tuberculin. In the advanced stages most careful observers will probably recognize it, or at least suspect it, without the use of tuberculin. Tuberculin, therefore, has become indispensable in giving the owner an idea of the inroads the disease is making in his herd, and in distinguishing the infected from the non-infected. Tuberculin reveals to us all stages, from the earliest, most insignificant changes, when the animal is outwardly entirely well, to the gravest and most dangerous types of the disease. Tuberculin does not, as a rule, discriminate between these cases. Hence those who use it as a guide must not be disappointed when, after having killed the suspected ones, they find that many are in the earlier stages of the malady. Tuberculin, moreover, is not infallible. A small percentage of cases of disease is not revealed by it. On the other hand, a sound animal now and then gives the reaction for tuberculosis. These lapses must be borne in mind in using tuberculin. In spite of them, however, tuberculin must be considered as of great value in revealing tuberculosis not recognizable by any other means during life.

In the report on tuberculosis in cattle, presented to the city council of Minneapolis, Minn., H. N. Avery, A.M., M.D., commissioner of health, states as follows: —

During the past few years the investigation of the prevalence of tuberculosis among dairy herds has been extensively carried on both in foreign countries and in the United States. In this country the work has been in charge of the Bureau of Animal Industry, the cattle commissions, boards of health and experiment stations of the several States. The results of such investigations have demonstrated the prevalence of the disease to an extent which is positively alarming in many herds, and its existence in a greater or less degree in a large proportion of the herds which have been examined. The diagnosis of this disease by ordinary methods being in many cases impossible, a more trustworthy method has been sought and found. In 1880, Koch, who discovered the bacillus or germ of the disease, described the preparation and uses of a fluid which he had prepared, and which has since come to be known as Koch's lymph or tuberculin. Tuberculin consists of the concentrated, sterilized liquids in which the bacillus tuberculosis has been grown. It contains no living bacilli, but it does contain the chief poisons which are produced

> within the tuberculous body, and which bring about all the diseased processes in such body. The diagnostic value of tuberculin depends upon the fact that, when injected into the body of a tuberculous animal, it increases the activity of the disease process in the tubercular tissues and thus affects the whole body, producing a reaction or rise of temperature in a marked degree. When injected into a healthy animal no reaction occurs, no decided rise of temperature results, and no effect is produced upon the health of the animal, either immediately or subsequently, although with tuberculous animals it in many cases accelerates the progress of the disease. The tuberculin test has been applied in many thousand cases, and the more extensively it has been used the more thoroughly it is appreciated for its diagnostic value and for the reliability of its indications when intelligently applied by skilful veterinarians.
>
> The results of the use of tuberculin as a test in dairy herds in and about Minneapolis have been such as to demonstrate its existence in such a proportion of cattle examined as to justify the continuance of such investigation in a thorough manner, with a view to the eradication of the disease.

In pursuance of this recommendation, an ordinance was passed by the Board of Health of the city of Minneapolis, under the provisions of the State law, forbidding the offering for sale of milk except from herds that are certified by an inspector to be free from disease. This ordinance provides: —

> It shall be the duty of the commissioner of health to cause to be made by the veterinarian of the department of health, or under his direction and supervision, such an examination of each and every animal producing milk for sale or consumption within the city of Minneapolis, and belonging to or controlled by such applicant, for the presence or absence of tuberculosis and other contagious and infectious diseases as shall be prescribed by the department of health; and the branding or tagging of each and every animal thus examined in such a manner as may be directed by the department of health, —

and the department of health requires that such inspection shall be based upon the tuberculin test, being the only reliable test.

On September 12 the United States Veterinary Medical Association, assembled at Des Moines, Ia., passed the following resolutions, which were adopted by a unanimous vote: —

> *Whereas*, Tuberculosis is an infectious disease, dangerous alike to

man and the lower animals; *and whereas*, scientific experimentation has demonstrated the possibility of transmitting the disease through the dairy and other animal products from tuberculous animals; *and whereas*, the extensive use of tuberculin as a diagnostic agent has thoroughly demonstrated its high value for that purpose, further be it

Resolved, That, in the judgment of the United States Veterinary Medical Association, it is the duty of sanitary boards and other health officers to employ all practical methods calculated to restrict this disease.

Resolved, That we regard the tuberculin test as the only reliable means now known to the scientific world for detecting obscure cases of tuberculosis in the living subject, and that it is a reliable test when performed under proper and well-known necessary conditions.

It is further *Resolved*, That reliance upon the physical examination of animals for the existence of tuberculosis is unwise and unwarranted in the present day.

Prof. H. D. Gill, veterinarian to the New York City Board of Health, in a recent paper read before the section of public health of the New York Academy of Medicine, November 8, stated, among other things, as follows: —

The identity of bovine and human tuberculosis being placed beyond doubt by the numerous examples of contagion, by a similarity in the anatomical alterations of these diseases, and by the existence in both of the same specific bacillus, the question of consumption of the milk of tuberculous animals becomes of the greatest importance from the stand point of public hygiene. How widespread it is can be learned, in my opinion, only when every animal has been subjected to the tuberculin test; and until such investigation has been made, the only safeguard for the milk supply of New York is limitation to that coming from herds which have been so tested. Too great emphasis can hardly be laid on the clearly demonstrated fact that tuberculosis may exist in cattle when they present absolutely no clinical symptoms of disease. Danger is not to be especially looked for when an animal presents the classical symptoms of emaciation, cough, etc. It is when the animal is in good flesh, has a healthy skin, and nevertheless has one or more foci of disease.

Turning now from the opinions as expressed by boards and authorities throughout the United States, some of which have been above quoted, we find that the same experience has been met abroad. At the last European Veterinary Congress, assembled at Berne, Switzerland, in September, the following resolutions were passed: —

> Tuberculin is a very valuable diagnostic agent, and can yield the greatest assistance in combating tuberculosis. There is no reason for objecting to its general application on the ground that it may aggravate pre-existing tuberculous lesions.
>
> The congress expresses the desire that governments shall order the employment of tuberculin in herds in which the existence of tuberculosis has been established.
>
> Tuberculin is a reliable diagnostic agent.
>
> There need be no fear that tuberculin, properly used, will cause generalization of pre-existing disease.
>
> All tuberculous herds should be tested with tuberculin, and the tuberculous and healthy animals separated.

The last International Congress of Hygiene, held in September, at Budapest, after hearing the report of the committee appointed two years before for the consideration of this question, reached the following conclusion, which was given out by the presiding officer: —

> The committee are agreed that tuberculin is a very valuable assistant in the discovery of tuberculosis. The occasional failures in diagnosis for which it is responsible are without practical significance.

In Dieckerhoff's "Lehrbuch der speciellen Pathologie und Terapie fur Thierarzte," published in 1894, and generally recognized as the most reliable work on veterinary practice, this statement occurs: —

> It is for the owner's interest to have his herd tested with tuberculin, in order to discover the suspicious animals, so that they may be separated and placed in another stable, and slaughtered as soon as possible.

A law is now pending in France which will make the use of tuberculin compulsory in all herds in which tuberculosis has been discovered.

Under the provisions of this law, every beast presenting clinical signs of disease is to be slaughtered; any suspicious beast showing tuberculosis is to be subjected to the tuberculin test, and slaughtered if diseased; all cattle that have cohabited with an animal found to be tuberculous are to be subjected to the tuberculin test; one-half to one-fourth compensation is to be paid, according to circumstances.

In presenting this bill, the minister explains that he desires to encourage the owners of cattle to assist the authorities in attempting to suppress a disease dangerous to human life, and that the differences as to compensation are arranged accordingly.

The city of Rome is putting in force regulations in relation to the health of milch cows and other animals which supply milk to its residents, which provide, in substance, that —

> All milch cows and other animals which supply milk in the suburbs and Agro Romano will be subjected to a rigorous examination by the municipal surgeons. To this purpose notice of every animal introduced into the Commune must be given to the health authorities before the milk can be sold, and it is then placed under the inspection of the veterinary surgeon.
>
> When the animal is healthy and capable of furnishing good milk, it will be marked in the horn and a special license given to the owner. These animals will be inspected every year, in the months of April, May and June, and also on any other occasion that the authorities may deem necessary. The cow suspected of tuberculosis will be treated with tuberculin at the expense of the owners, and those diseased will be slaughtered.

These regulations have recently been extended to embrace all the surrounding country, which will prevent the owners in Rome proper from sending tuberculous cows into the adjoining country, where they might continue to be the source of milk supply for the city.

Numerous other quotations might be inserted of the doings of public authorities and the opinions of experts upon the matter of the reliability of tuberculin; but a sufficient number have been cited to show that everywhere it is the consensus of opinion that in tuberculin a reliable diagnostic agent for the detection of tuberculosis has been found, and that with its discovery an entirely new phase has been put upon the problem of the eradication of this disease in cattle, and with it the elimination of this source of danger to the public health.

We assume, therefore, that tuberculin is a reliable agent for the detection of bovine tuberculosis.

The consideration of the question as to whether or not the use of tuberculin accelerates the disease already existing in the animal is of no importance, because, under the law of this State and of every other State where any action is being taken, the authorities destroy the animal where the disease is found, and this is the object primarily sought to be accomplished by the application of the test. Unless this policy is pursued, the disease can never be eradicated.

This being so, no evil can arise under any aspect in applying the tuberculin test to animals which are in fact diseased. Inasmuch as authorities are united in the opinion that the presence of the disease cannot be detected until after the tuberculin is applied, in the vast majority of cases, we are necessarily not in position to apply the tuberculin only to diseased animals; and it must necessarily follow that in the adoption of this test a certain proportion of healthy animals must be subjected to the influence of tuberculin, in endeavoring to ascertain by its use which of them are diseased.

The only material question in this connection, therefore, is, does the use of tuberculin in any way injure healthy animals? That tuberculin cannot produce the disease of tuberculosis is a matter of absolute certainty. This was thoroughly discussed in the report of this commission last year.* As bearing upon this matter, we desire to call the attention of your honorable body to the fact that in the following cases herds which have been once tested and the premises properly disinfected by the members of this Board have been retested after periods as shown in the table, and found to be entirely free from tuberculosis, which shows not only that the test is reliable, but also that it did not produce the disease.

Number.	First Test.			Second Test.		
	Date.	Number Animals.	Number Tuberculous.	Date.	Number Animals.	Number Tuberculous.
1	Feb. 4, 1894,	120	18	July 12, 1895,	80	-
2	Oct. 1, 1894,	80	36	Sept. 19, 1895,	80	-
3	April 13, 1894,	27	16	April 15, 1895,	9	-
4	June 21, 1894,	23	6	Dec. 27, 1895,	23	-
5	May 16, 1895,	51	7	Dec. 27, 1895,	53	-

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* Nor has it ever been shown that the use of tuberculin has been productive of any other ill results in animals to which it has been administered; while, on the other hand, authority after authority have declared that in their experience it has never produced ill results when administered to other than tuberculous animals.

The commission has endeavored during the past year to carefully observe the effect of the use of this diagnostic agent upon the healthy animals, and no case has been brought to the attention of the commission in which any injury could be directly traced to the use of tuberculin. Perhaps no better evidence can be obtained of the general opinion that tuberculin produces no injurious effect upon healthy animals than the fact that in the open markets of this Commonwealth animals which have been so tested sell more readily in competition with untested animals, and at, if anything, better prices.

Further, but few thoroughbred or pedigree animals can be sold to-day unless such animals are accompanied by a certificate of having successfully passed the tuberculin test; and finally, as is shown by the recent experience of this commission, the greatly increased and increasing number of applications for the test, coming from all parts of the State.

SANITATION.

The matter of the sanitary condition of stables and premises is an important one in connection with the consideration of the general health of animals, and is particularly so in all questions concerning the eradication of tuberculous disease. The question of whether an animal will become affected with tuberculosis depends upon two conditions: first, the presence of the germ; second, a receptive condition of the individual which will enable any germs which may obtain lodgement to develop and multiply and thus produce the disease.

In order to suppress tuberculosis, it is necessary not only to destroy the diseased animals, but to remove other sources of contagion by means of cleansing and disinfecting stables; and also to see that the animals are kept under such proper sanitary conditions as will render them practically immune to contagion which may be presented to them.

In view of the great prevalence of this disease throughout the neat stock of the Commonwealth, the commission feels that the first important step is to destroy the main sources of contagion, — that is, the diseased animals, — and that, upon this being done, the premises should be disinfected and otherwise put into proper sanitary condition. It is useless to prescribe sanitary regulations and go through the expensive process of properly cleansing and disinfecting stables until all diseased animals within the enclosure have been picked out and removed. Therefore the matter of sanitation becomes especially important in cases where herds have been examined by the Board and the disease removed.

In all cases where entire herds have been examined by this commission upon voluntary request, the owner has agreed that he "will observe the sanitary regulations prescribed by the Board of Cattle Commissioners, and will not introduce into such herd any animals without having them first subjected to the tuberculin test." After the examination of the herd has been completed, and the diseased animals removed, the Board has given directions for the proper disinfection of the premises, as follows: all animals are to be removed from the barn; all woodwork with which they have been in direct or indirect contact is to be thoroughly scraped; all floors, ceilings and walls to be sprinkled with water and thoroughly swept; after this has been done, live steam, or, failing that, boiling water, is to be applied freely to all parts with which the animals have been in contact; this having been done and allowed to dry, the premises are to be again scraped and swept; the buildings are then to be closed as tightly as possible, and subjected to the effects of chlorine gas. This gas can be easily made by treating chloride of lime with crude sulphuric acid diluted with three or four parts of water, in sufficient quantities to thoroughly fill all parts of the building, which is then left closed for twelve hours. Following this, all the woodwork is to be treated with whitewash to which has been added a solution of bi-chloride of mercury, one part of mercury to one thousand parts of water, the application to be made by means of a force pump. When this is dry the premises are ready to be used again. It is desirable that this whitewash should be repeated at convenient intervals, for two or three times.

It is the intention of the Board to continue the work of the examination of stables, such as has already been inaugurated, and to furnish to parties interested instructions in regard to what sanitary conditions are deemed advisable by the Board, and as to how these ends may be accomplished.

To this end owners of stock are advised that any building used as a stable for cows should be properly lighted and ventilated; should have a tight floor and roof; good drainage connecting wherever possible with a practicable sewer pipe and supply of pure water and not less than one thousand cubic feet of air space for each animal; that manure should not be allowed to accumulate in the neighborhood; that yards surrounding buildings where cows are kept should be well drained, free from standing water and filth; that barns should be swept once at least each day, and kept as clean as possible, and the floors should be sprinkled before being swept; that no hogs or manure should be kept in the cellars under cow stables; that animals kept for the production of milk should not be fed upon swill of any kind.

The commission would also advise that, as far as practicable, consumptive people should not be allowed to come in any way in contact with neat cattle; although in this connection it should be stated that modern investigation tends more and more to show that, while the danger of the transmission of tuberculosis from the lower animals to man is great, the danger of transmission in the other direction is not so great as has been supposed.

Laboratory experiments indicate that the bacillus from the human subject is much less virulent than that from the bovine. Comparative microscopical examinations show clearly the rugged, hardy appearance of the bovine, as compared with the slender, bent bacillus of man; and the growth of the cultures together in the same media have demonstrated that the bacillus of the bovine kills out the bacillus from the human subject.

In 1864 Villimen, and in 1869 Klebs, produced tuberculosis in calves by injecting tuberculous masses from man into their peritoneal cavity; but these experiments are directly offset by those conducted by Prof. Theobald Smith, who has recently informed us that with the pure culture of the bacilli, procured from the animal pet of a consumptive man, he had been unable, by injection into the peritoneal cavity of bovines, to reproduce the disease; and, while tuberculisoidin and other antitoxines have marked beneficial effect upon cases of the disease, which resulted from the inoculation of the bacilli from man, it had no such salutary effect when injected into animals which had derived the disease from the bovine virus. This was confirmed by experiments on three guinea-pigs which had been inoculated with bovine virus, and were afterward treated with one of these preparations furnished by Dr. E. Klebs. After the disease was well advanced the treatment had not the slightest effect upon its progress.

The same results were obtained by Czaplewski and Roloff in 1892 (Berlin, Klein Wochenscrift, No. 29).

While these experiments may not be conclusive, they all point in the same direction.

Under the provisions of section 1 of the law of 1895 it was provided that inspectors "shall make, from time to time, inspections of all other domestic animals within the limits of their several cities and towns, whenever they have knowledge or reason to suspect that such animals are affected with or have been exposed to any contagious disease; and they shall immediately inspect any and all domestic animals, and any barn, stable or premises where any such animals are kept, whenever directed so to do by the Board of Cattle Commissioners or any of its members."

No special directions under this section have been given to the inspectors, for the reason that so little is known as to the conditions of these stables; and the method of properly inspecting them is so difficult that the preliminary work, at all events, must be done by special inspectors properly qualified for that purpose; and therefore the Board has undertaken to make a special study of the sanitary conditions of the stables, after which it will be able to issue general instructions to the inspectors, which will be productive of great good in this direction. The agent appointed by the Board inspected twenty-five stables picked out in different parts of the State, and the result of this inspection will be seen in the following table: —

Summary of Laboratory Reports on Hygienic Conditions of Barns inspected during Month of October, 1895.

Number.	TOWN.	Date.	Time.	Brewery Grain.	Hogs kept in Cellar.	Number of Animals.	Cubic Feet of Air Space per Head.	Carbonic Acid in 10,000 Parts of Air.	Condition of Air.	Number Bacteria in Ten Litres Air.	Condition of Water.
1,	Natick, . .	Oct. 11,	A. M. 5.40	Used in part,	No,	3	933	Parts. 8	Fair, .	350	Good.
2,	Natick, . .	Oct. 12,	4.30	None used, .	No,	15	307	10	Bad, .	–	Good.
3,	Southborough,	Oct. 15,	5.20	None used, .	No,	5	420	8	Fair, .	160	Good.
4,	Southborough,	Oct. 15,	4.10	None used, .	No,	60	320	12	Bad, .	500	Impure.
5,	Westborough,	Oct. 15,	5.00	None used, .	No,	15	303	9	Bad, .	230	Good.
6,	Westborough,	Oct. 15,	5.40	None used, .	No,	20	378	–	Fair, .	270	Good.
7,	Worcester, .	Oct. 22,	4.15	Is used, .	25 hogs,	30	426	12	Bad, .	170	Impure.
8,	Worcester, .	Oct. 22,	4.00	None used, .	No,	33	1,221	10	Bad, .	1,130	Fair.
9,	Worcester, .	Oct. 22,	6.30	None used, .	15 hogs,	40	300	7.5	Fair, .	–	Good.
10,	Worcester, .	Oct. 22,	5.45	None used, .	15 hogs,	25	512	8	Fair, .	400	Fair.
11,	Quincy, . .	Oct. 26,	6.00	Is used, .	No,	9	522	8	Fair, .	170	Dangerous.
12,	Quincy, . .	Oct. 26,	5.10	None used, .	No,	9	266	9	Bad, .	350	Good.
13,	South Natick,	Oct. 26,	4.30	None used, .	No,	19	–	11	Bad, .	490	Fair.
14,	Dover, . .	Oct. 26,	5.45	None used, .	No,	6	–	14	Very bad,	420	Good.

Summary of Laboratory Reports on Hygienic Conditions of Barns inspected during Month of November, 1895.

			A. M.					Parts.			
1,	Holliston,	Nov. 1,	4.30	No,	No,	7	330	12	Bad,	570	Poor.
2,	Holliston,	Nov. 1,	5.15	No,	Yes,	1	1,100	7½	Fair,	140	Good.
3,	Milford,	Nov. 1,	5.45	No,	Yes, 25,	23	311	7	Fair,	800	Fair.
4,	Waltham,	Nov. 15,	6.00	No,	No,	33	1,600	6	Good,	660	Poor.
5,	Waltham,	Nov. 15,	5.15	No,	–	12	420	9	Bad,	400	Fair.
6,	Burlington,	Nov. 19,	5.55	No,	No,	43	1,400	8	Fair,	450	Good.
7,	Woburn,	Nov. 19,	4.50	No,	No,	17	325	7	Fair,	250	Good.
8,	Weston,	Nov. 29,	6.00	No,	No,	12	875	7	Fair,	750	Poor.
9,	Wayland,	Nov. 29,	6.45	No,	No,	8	1,300	7	Fair,	500	Good.
10,	Cochituate,	Nov. 29,	6.40	Yes,	Yes, 10,	16	2,500	6	Good,	200	Good.
11,	Cochituate,	Nov. 29,	6.05	Yes,	No,	36	1,700	7	Fair,	400	Good.

FINANCE.

Prior to the passage of the law of 1894, the law under which this commission had been operating was so unsatisfactory that little could be done. With the passage of the law of 1894 the work became enormously increased. The appropriation for that year was $35,000. Of this sum there had been expended prior to June 20, $13,000, leaving a balance of $22,000 on hand at the time when the law of 1894 was passed. Early in February, 1895, the Legislature appropriated $50,000 for the immediate use of this commission, that the work might be continued until such time as final legislation could be obtained. Prior to the passage of the law of 1895, obligations had been contracted under the law of 1894 up to June 5, 1895, to the amount of $91,876, leaving a balance unprovided for of $19,876, which had to be taken from the appropriation of $100,000 made under the law of 1895, which left a balance of only $80,124 to be expended under the new act.

In regard to the item of $19,876 in excess of the available appropriation of $72,000, above referred to, the commission desires to state that under the law it is impossible at any given moment to know just what the obligations of the commission are, because the inspectors throughout the State, who are independent public officers, are, under the provisions of the law, taking steps which ultimately must create a liability on the part of the State calling for the action of this commission, involving additional expense; and, further, that the returns of expenses and numbers of claims come in frequently long after the time when the animal was killed, and the obligation is technically incorrect.

Of the $91,876 expended under the law of 1894, $44,376 was for administrative expenses; $47,500 was returned directly to the owners of cattle destroyed as tuberculous, upon the basis of one-half sound value of animals destroyed, — an average price, therefore, of $21 per head; so that the expense of examining all animals reported as being suspicious, conducting the examination of a large number of cattle every week at Brighton, as well as that inseparably connected with the inauguration of a new and very large plant, such as buying the necessary apparatus, fitting up quarantine stations, preparation of forms, printing and payment of all other incidental expenses, was as $44,376 is to $47,500.

At the same time it should be remembered, in comparing this work with the work under the present law, that under the law of 1894 the owners of neat stock destroyed received one-half the sound value, whereas under the present law the full value was paid. The average value of animals paid under the law of 1895 has been $35 per head. Had the same valuation been paid under 1894, the relation of administrative expense to the amount paid in compensation would have been in the proportion of $44,376 to $78,750.

It should also be remembered in this connection that up to June 30, or substantially during the greater portion of the period of the law of 1894, the State sustained the entire expense of examining neat cattle brought from without its border for the purpose of determining whether or not they were free from tuberculosis; whereas, under the regulations prescribed by this commission relating to interstate cattle, since July, 1895, substantially all neat stock brought within the borders of the Commonwealth now are accompanied by certificate of tuberculin test, which is furnished at the expense of the owner, and is signed by a veterinarian whose integrity and ability is vouched for by the Board of Cattle Commissioners of the State from which the animals were shipped, thus relieving Massachusetts of an immense burden of expense which was borne by it during the experimental work carried on at Brighton, Watertown and Somerville.

From June 5, 1895, to Nov. 25, 1895, the total amount expended by the commission against the available fund of $80,124 has been $75,600, of which the total administrative expense was $16,100, and the amount paid to the owners of neat cattle destroyed as tuberculous, under the provisions of the act, $59,500. This sum was paid for 1,732 animals destroyed, or an average price of about $34.50 per head. These figures, therefore, show that the administrative expense was, as compared with the expense of compensation, as $16,100 is to $59,500. In other words, since June 5, 1895, the administrative expense has been twenty-seven per cent. and the expense for compensation of animals destroyed seventy-three per cent. It will thus be seen that, out of every dollar spent by this commission since June 5, 1895, the farmers have received seventy-three cents.

It may be of interest to note the State tax paid by each city and town throughout the Commonwealth, and the amount paid out of the treasury of the Commonwealth to the owners of cattle within such city or town. These figures may be ascertained by consulting the following table: —

CITY OR TOWN.	Tax.	Cattle.	CITY OR TOWN.	Tax.	Cattle.
Abington,	$1,500	–	Boxford,	$375	$86 25
Acton,	900	$289 00	Boylston,	300	44 50
Acushnet,	375	20 00	Bradford,	1,650	50 00
Adams,	2,310	–	Braintree,	2,670	–
Agawam,	810	367 00	Brewster,	375	100 00
Alford,	135	–	Bridgewater,	1,515	548 68
Amesbury,	3,135	55 25	Brimfield,	255	31 00
Amherst,	1,905	779 50	Brockton,	12,930	616 75
Andover,	2,940	562 25	Brookfield,	900	182 75
Arlington,	4,830	151 50	Brookline,	35,685	804 50
Ashburnham,	645	220 75	Buckland,	360	141 50
Ashby,	315	1,053 45	Burlington,	300	702 00
Ashfield,	315	1,216 50	Cambridge,	46,800	60 00
Ashland,	735	806 92	Canton,	2,595	469 50
Athol,	2,265	–	Carlisle,	210	401 50
Attleborough,	2,760	22 00	Carver,	495	–
Auburn,	345	69 75	Charlemont,	240	32 50
Avon,	465	–	Charlton,	585	27 00
Ayer,	825	–	Chatham,	570	–
Barnstable,	2,310	45 00	Chelmsford,	1,245	1,264 00
Barre,	885	1,627 75	Chelsea,	13,545	21 50
Becket,	285	55 00	Cheshire,	450	625 00
Bedford,	585	–	Chester,	390	962 00
Belchertown,	340	321 50	Chesterfield,	180	206 50
Bellingham,	420	104 75	Chicopee,	4,980	–
Belmont,	2,265	97 75	Chilmark,	135	–
Berkley,	270	–	Clarksburg,	150	–
Berlin,	300	–	Clinton,	4,170	249 50
Bernardston,	255	–	Cohasset,	2,880	112 50
Beverly,	8,685	137 49	Colrain,	360	23 00
Billerica,	1,185	5,606 45	Concord,	2,520	364 25
Blandford,	270	54 00	Conway,	435	272 50
Bolton,	285	652 30	Cottage City,	640	–
Boston,	538,920	8,151 68	Cummington,	195	535 75
Bourne,	1,005	18 50	Dalton,	1,755	1,838 00
Boxborough,	135	95 25	Dana,	160	24 00

CITY OR TOWN.	Tax.	Cattle.	CITY OR TOWN.	Tax.	Cattle.
Danvers,	$2,700	-	Groveland,	$600	$35 00
Dartmouth,	1,620	$6 00	Hadley,	630	291 25
Dedham,	3,945	317 00	Halifax,	165	-
Deerfield,	990	134 75	Hamilton,	645	-
Dennis,	1,005	8 50	Hampden,	340	116 75
Dighton,	510	-	Hancock,	210	28 00
Douglas,	630	119 75	Hanover,	870	15 50
Dover,	385	225 50	Hanson,	390	-
Dracut,	1,005	496 00	Hardwick,	930	397 23
Dudley,	675	618 50	Harvard,	615	830 75
Dunstable,	180	1,185 50	Harwich,	750	-
Duxbury,	945	39 85	Hatfield,	630	193 00
East Bridgewater,	990	48 75	Haverhill,	12,630	1,114 02
East Longmeadow,	420	612 75	Hawley,	105	-
Eastham,	180	-	Heath,	120	-
Easthampton,	1,500	252 75	Hingham,	2,750	90 00
Easton,	3,045	14 75	Hinsdale,	465	-
Edgartown,	450	29 00	Holbrook,	810	-
Egremont,	285	-	Holden,	720	-
Enfield,	480	36 25	Holland,	66	-
Erving,	240	165 50	Holliston,	1,035	328 50
Essex,	600	-	Holyoke,	16,320	711 00
Everett,	7,380	-	Hopedale,	1,560	-
Fairhaven,	1,135	41 50	Hopkinton,	1,260	245 25
Fall River,	37,320	201 00	Hubbardston,	420	350 75
Falmouth,	3,675	300 50	Hudson,	1,785	154 75
Fitchburg,	11,880	215 00	Hull,	1,560	21 75
Florida,	105	-	Huntington,	330	-
Foxborough,	1,020	130 25	Hyde Park,	1,585	-
Framingham,	5,595	2,295 00	Ipswich,	1,770	514 25
Franklin,	1,800	1,448 40	Kingston,	1,005	-
Freetown,	540	59 25	Lakeville,	345	-
Gardner,	3,045	3,687 28	Lancaster,	1,785	64 00
Gay Head,	15	-	Lanesborough,	315	12 00
Georgetown,	645	-	Lawrence,	19,920	64 50
Gill,	285	428 53	Lee,	110	1,215 25
Gloucester,	9,750	-	Leicester,	1,410	78 00
Goshen,	90	38 00	Lenox,	1,785	413 78
Gosnold,	120	22 50	Leominster,	3,420	1,203 50
Grafton,	1,485	243 00	Leverett,	180	-
Granby,	285	96 00	Lexington,	2,445	960 25
Granville,	225	10 25	Leyden,	105	57 00
Great Barrington,	2,205	46 00	Lincoln,	1,380	147 00
Greenfield,	3,195	119 75	Littleton,	525	1,898 44
Greenwich,	165	10 50	Longmeadow,	375	224 25
Groton,	1,753	637 50	Lowell,	42,000	329 25

City or Town.	Tax.	Cattle.	City or Town.	Tax.	Cattle.
Ludlow, . .	$645	$466 00	Newton, . .	$27,495	$777 00
Lunenburg, . .	480	117 25	Norfolk, . .	315	–
Lynn, . . .	29,715	1,083 42	North Adams, .	4,695	–
Lynnfield, . .	360	–	North Andover, .	2,025	697 75
Malden, . .	14,835	212 50	No. Attleborough,	2,400	72 75
Manchester, .	4,260	5 00	North Brookfield,	1,200	390 25
Mansfield, . .	1,095	60 50	North Reading, .	315	329 75
Marblehead, .	3,465	–	Northampton, .	6,270	322 50
Marion, . .	495	26 50	Northborough, .	765	3,086 45
Marlborough, .	4,965	1,720 99	Northbridge, .	2,175	330 06
Marshfield, . .	810	295 50	Northfield, . .	585	446 66
Mashpee, . .	105	–	Norton, . .	495	305 00
Mattapoisett, .	900	64 33	Norwell, . .	660	1,250 00
Maynard, . .	1,260	35 25	Norwood, .	1,645	893 75
Medfield, . .	855	–	Oakham, . .	210	–
Medford, . .	9,345	185 00	Orange, . .	2,415	169 75
Medway, . .	795	128 50	Orleans, .	520	–
Melrose, . .	5,895	–	Otis, . .	135	–
Mendon, . .	330	167 00	Oxford, .	795	–
Merrimac, . .	810	–	Palmer, .	1,740	118 50
Methuen, . .	2,115	98 00	Paxton, . .	165	–
Middleborough, .	2,550	10 00	Peabody, . .	4,693	233 50
Middlefield, .	150	–	Pelham, . .	105	12 50
Middletown, .	315	–	Pembroke, . .	405	39 25
Milford, . .	3,315	47 50	Pepperell, . .	1,230	1,197 25
Millbury, . .	1,440	79 00	Peru, . . .	75	–
Millis, . . .	510	157 50	Petersham, . .	390	71 75
Milton, . .	11,775	150 00	Phillipston, . .	180	–
Monroe, . .	90	–	Pittsfield, . .	8,070	818 45
Monson, . .	1,200	606 75	Plainfield, . .	105	–
Montague, . .	2,180	–	Plymouth, .	3,960	–
Monterey, . .	150	–	Plympton, . .	195	–
Montgomery, .	90	–	Prescott, . .	105	58 25
Mt. Washington, .	45	–	Princeton, . .	495	906 84
Nahant, . .	3,465	–	Provincetown, .	1,365	–
Nantucket, . .	1,850	183 25	Quincy, . .	10,095	360 00
Natick, . .	3,420	529 00	Randolph, . .	1,410	17 50
Needham, . .	1,695	131 25	Raynham, . .	540	148 00
New Ashford, .	45	–	Reading, . .	2,100	30 00
New Bedford, .	30,915	31 00	Rehoboth, . .	450	95 75
New Braintree, .	255	666 50	Revere, . .	3,930	–
New Marlborough,	345	185 00	Richmond, . .	210	–
New Salem, .	195	51 00	Rochester, . .	330	–
Newbury, . .	645	–	Rockland, . .	1,860	68 00
Newburyport, .	6,735	–	Rockport, . .	1,590	205 59

CITY OR TOWN.	Tax.	Cattle.	CITY OR TOWN.	Tax.	Cattle.
Rowe,	$150	–	Topsfield,	$525	$392 50
Rowley,	420	–	Townsend,	720	946 75
Royalston,	375	$25 00	Truro,	225	15 00
Russell,	300	52 50	Tyngsborough,	240	272 00
Rutland,	315	–	Tyringham,	135	–
Salem,	17,550	25 00	Upton,	630	–
Salisbury,	390	–	Uxbridge,	1,365	–
Sandisfield,	210	31 50	Wakefield,	3,510	171 50
Sandwich,	585	32 25	Wales,	180	–
Saugus,	1,770	–	Walpole,	1,245	183 70
Savoy,	105	25 00	Waltham,	11,190	2,420 50
Scituate,	1,230	–	Ware,	2,655	474 25
Seekonk,	525	–	Wareham,	1,260	–
Sharon,	975	37 00	Warren,	1,680	287 25
Sheffield,	540	1,030 50	Warwick,	195	30 25
Shelburne,	555	1,111 00	Washington,	120	77 25
Sherborn,	495	1,355 00	Watertown,	4,890	1,333 00
Shirley,	450	65 00	Wayland,	945	823 50
Shrewsbury,	600	–	Webster,	2,310	45 00
Shutesbury,	105	–	Wellesley,	3,990	1,110 50
Somerset,	645	48 56	Wellfleet,	465	102 50
Somerville,	25,890	30 00	Wendell,	150	–
South Hadley,	1,410	54 00	Wenham,	405	–
Southampton,	300	29 25	West Boylston,	825	170 20
Southborough,	975	4,875 75	West Bridgewater,	600	355 75
Southbridge,	2,445	231 00	West Brookfield,	510	–
Southwick,	330	37 50	West Newbury,	600	–
Spencer,	2,505	14 25	West Springfield,	2,475	219 00
Springfield,	35,203	575 00	West Stockbridge,	345	–
Sterling,	525	447 40	West Tisbury,	240	11 00
Stockbridge,	1,860	80 00	Westborough,	1,580	2,331 25
Stoneham,	2,430	91 75	Westfield,	4,755	37 50
Stoughton,	1,815	95 50	Westford,	825	719 25
Stowe,	390	590 25	Westhampton,	150	245 75
Sturbridge,	585	90 75	Westminster,	465	676 74
Sudbury,	705	82 50	Weston,	2,145	–
Sunderland,	235	718 83	Westport,	945	26 50
Sutton,	810	270 85	Weymouth,	4,095	–
Swampscott,	3,390	–	Whately,	285	338 25
Swanzey,	525	–	Whitman,	2,190	182 75
Taunton,	11,970	60 00	Wilbraham,	510	184 00
Templeton,	840	391 25	Williamsburg,	570	221 00
Tewksbury,	900	720 75	Williamstown,	1,515	–
Tisbury,	495	–	Wilmington,	540	210 50
Tolland,	90	–	Winchendon,	1,410	51 25

City or Town.	Tax.	Cattle.	City or Town.	Tax.	Cattle.
Winchester, .	$3,885	$20 00	Worthington, .	$195	$20 00
Windsor, . .	120	31 00	Wrentham, . .	915	279 25
Winthrop, . .	2,610	-	Yarmouth, . .	1,260	-
Woburn, . .	5,820	357 50			
Worcester, . .	54,435	1,033 30	Total, . .	-	$111,561 50*

Opinions of Persons throughout the Commonwealth who have had Animals tested with Tuberculin by this Board.

Desiring to ascertain as fully as possible the experience and opinions of those whose animals had been subjected to the tuberculin test, the Board issued the following circular letter, a copy of which was sent to the address of every person whose animals had been tested prior to that date.

The total number of replies coming from this circular has been two hundred and forty-three, of which forty-five only are unfavorable to the test. All are given herewith. The name and address of the writer is given in every case in which it has been received.

Some of the replies have been given as directly answering the numbered questions, and others in letter form, without regard to the numbers of the inquiries. To save repetition here, the answers received are given following the number of the question which is answered. The letters are given together, and will be found following the more direct replies.

The unfavorable replies have been separated from the others, and are given first. It is a notable fact that, of the thirty-four classified unfavorable opinions, all but six are from persons whose animals showed no tuberculosis upon application of the test, and who, therefore, it is to be presumed, have had no opportunity of witnessing the great precision with which the test does its work. It is also to be noticed that almost all of the more usual calamities attending the keeping of milch cows have been ascribed to the bad effects of tuberculin, chief among them being the shrinkage of the product in milk and the occurrences of abortion, with its attending evils. That tuberculin is, probably, not properly chargeable with these unfortunate happenings, is well shown by the replies and letters received from the great majority of these correspondents themselves, to be found among those that are classed here as not unfavorable.

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* It will be noticed that these figures show a sum which is larger by some $4,000 than the sum of the amounts returned in this report as having been paid to the farmers for cattle destroyed. This is due to the fact that a number of the warrants for animals already condemned and destroyed, amounting to about $4,000, had not been sent to the auditor at the time when the latter figures were made up.

Among these latter it will be noticed that there are thirty-eight replies that are non-committal as to the opinion of the writers upon the value of the tuberculin test; thirty-two of them come from cases in which no tuberculosis was found in the examined herds, twenty-eight being from the systematic work in the Cape district, where, as is shown in another part of this report, an exceedingly small amount of tuberculosis exists among the neat stock.

[Copy of Circular Letter.*]

52 Village Street, Boston, Oct. 28, 1895.

Dear Sir: — We are desirous of learning as fully and accurately as possible as to the general health and thrift of your cattle which were tested with tuberculin. I would therefore consider it a favor if you would write me concerning the following points: —

1. When was your herd tested?
2. Of how many animals did it then consist?
3. How many were condemned as tuberculous?
4. How many of them were milch cows?
5. What was the comparative milk product before and after test?
6. What has been their general health since?
7. How many animals have you lost since the test?
8. What disease caused their death?
9. How many animals had you lost in the same length of time prior to the use of tuberculin?
10. What is your opinion of tuberculin from your experience with it in your own herd?

An early reply will oblige yours very truly,

Frederick H. Osgood, *Chairman.*

FREDERICK H. OSGOOD, *Chairman*,
CHARLES P. LYMAN, *Secretary*,
MAURICE O'CONNELL,
LEANDER F. HERRICK,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

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* On account of lack of space it has been thought best to omit the replies to this circular letter, which occupy some forty-three printed pages of the report.

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PUBLIC DOCUMENT . . . . No. 33.

EIGHTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1896.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1896.

REPORT.

It is proper, in making this first report of the Hatch Experiment Station since its consolidation with the State Experiment Station, that its history and organization should be briefly outlined and made a matter of permanent record. The State station was established by act of the Legislature in 1882, with Prof. Charles A. Goessmann as director. Though located on the college grounds and making use of its land for purposes of experiment, it had no direct connection with it, but was governed by its own board of control. Up to the time of consolidation twelve annual reports had been issued and fifty-seven bulletins.

The Hatch Experiment Station was established under act of Congress, Public No. 112, Feb. 25, 1887. The provisions of this act were accepted by the General Court, chapter 112 of the Acts and Resolves of 1887. At a meeting of the trustees of the Massachusetts Agricultural College, held March 2, 1888, it was voted to establish another department, to be styled "The Experiment Department of the Massachusetts Agricultural College." The name was subsequently changed to the Hatch Experiment Station of the Massachusetts Agricultural College, and Pres. H. H. Goodell was elected director. Five thousand dollars of its income were annually paid over to the State Experiment Station, in consideration of its performing the chemical work required. Previous to consolidation there had been issued seven annual reports, thirty general, three special and seventy-eight meteorological bulletins.

For several years a growing feeling had manifested itself that the two stations should be united, in the interest of economy of administration, work and result.

In 1894 an act was passed by the General Court, chapter 143, to consolidate the Massachusetts Agricultural Experiment Station with the Experiment Department of the Massachusetts Agricultural College. Owing to a trifling error, the consolidation could not be effected, and the act was amended, chapter 57 of the Acts and Resolves of 1895. The full text, as amended, is as follows: —

SECTION 1. The Massachusetts agricultural experiment station, located at the Massachusetts agricultural college in Amherst, may be transferred to and consolidated with the experiment department of the said college now known as the Hatch experiment station, in the manner hereinafter provided.

SECT. 2. The said Massachusetts agricultural experiment station, at any meeting duly called for such purpose, may, by a vote of two-thirds of the members present, authorize the transfer of all the rights, leases, contracts and property, of every kind and nature, of said station to the Massachusetts agricultural college; and the trustees of said college may, at any meeting duly called for such purpose, accept the same for said college in behalf of the Commonwealth, whereupon such transfer shall be made by suitable conveyance; and when such transfer shall be made, the said Massachusetts agricultural experiment station shall be deemed to be a part of, and to belong to, the experiment department of said college, under such name as said trustees may designate.

SECT. 3. The trustees of said college shall thereafter continue to carry on the experimental and other work for which the Massachusetts station was established, and to administer and apply all the property and funds that may be received by them hereunder, and by virtue hereof, for such purposes. They shall also from time to time print and publish bulletins containing the results of any experimental work and investigations, and distribute the same to such residents and newspapers of the Commonwealth as may apply therefor.

SECT. 4. Nothing herein contained shall operate to affect or discontinue the annual appropriations and payments thereof made and to be made by the Commonwealth for the proper maintenance of experimental work, under section six of chapter two hundred and twelve of the acts of the year eighteen hundred and eighty-two and section one of chapter three hundred and twenty-seven of the acts of the year eighteen hundred and eighty-five; and the payment of said appropriations shall hereafter be made to the treasurer of the Massachusetts agricultural college. The trustees of said college shall make or cause to be made annually to the general court a detailed report of the expenditure of all such moneys, and such further report of the annual work of the experiment department of the college station as the trustees of the college shall deem advisable.

In accordance with this action of the Legislature, at a special meeting of the trustees, held April 16, 1895, it was voted to accept, for the Massachusetts Agricultural College, the transfer of all the rights, leases, contracts and property of every kind and nature of the Massachusetts Agricultural Experiment Station to the Massachusetts Agricultural College. It was voted to consolidate the two stations, under the name of the Hatch Experiment Station of the Massachusetts Agricultural College, and the following organization was adopted: —

Henry H. Goodell, LL.D.,	*Director.*
William P. Brooks, B.Sc.,	*Agriculturist.*
George E. Stone, Ph.D.,	*Botanist.*
Charles A. Goessmann, Ph.D., LL.D.,	*Chemist* (fertilizers.)
Joseph B. Lindsey, Ph D.,	*Chemist* (foods and feeding.)
Charles H. Fernald, Ph D.,	*Entomologist.*
Samuel T. Maynard, B.Sc.,	*Horticulturist.*
Leonard Metcalf, B.S.,	*Meteorologist.*
Henry M. Thomson, B.Sc.,	*Assistant Agriculturist.*
Ralph E. Smith, B.Sc.,	*Assistant Botanist.*
Henri D. Haskins, B.Sc.,	*Assistant Chemist* (fertilizers).
Robert H. Smith, B.Sc.,	*Assistant Chemist* (fertilizers).
Charles S. Crocker, B Sc.,	*Assistant Chemist* (foods and feeding).
Edward B. Holland, B.Sc.,	*Assistant Chemist* (foods and feeding).
Robert A. Cooley, B.Sc.,	*Assistant Entomologist.*
Joseph H. Putnam, B.Sc.,	*Assistant Horticulturist.*
George A Billings, B.Sc.,	*Assistant in Foods and Feeding.*
Charles A. King,	*Observer.*

ANNUAL STATEMENT

Of the Hatch Fund of the Massachusetts Agricultural College for the Year ending June 30, 1895.

By George F. Mills, *Treasurer pro tem.*

Cash received from United States treasurer,		$15,000 00
Cash received from agricultural department,		861 14
		$15,861 14
Cash paid for salaries,	$8,382 72	
Cash paid for labor,	1,592 88	
Cash paid for publications,	1,476 16	
Cash paid for freight and express,	103 53	
Cash paid for postage and stationery,	51 41	
Cash paid for heat, light and water,	101 90	
Cash paid for chemical supplies,	479 60	
Cash paid for seeds, plants and sundry supplies,	500 71	
Cash paid for fertilizers,	344 08	
Cash paid for feeding stuffs,	373 52	
Cash paid for library,	528 23	
Cash paid for tools, implements and machinery,	867 27	
Cash paid for furniture,	50 92	
Cash paid for scientific apparatus,	534 56	
Cash paid for travelling expenses,	195 37	
Cash paid for contingent expenses,	96 42	
Cash paid for building and repairs,	181 86	
		$15,861 14

Amherst, Mass., Sept. 20, 1895.

I, the undersigned, duly appointed auditor, do hereby certify that I have examined the books and accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ending June 30, 1895; that I have found the books well kept, and the accounts correctly classified as above, and that the receipts for the time named are shown to be $15,861.14, and the corresponding disbursements $15,861.14. All the proper vouchers are on file, and have been by me examined and found to be correct, there being no balance to be accounted for in the fiscal year ending June 30, 1895.

CHARLES A. GLEASON,
Auditor.

REPORT OF THE BOTANIST.

GEORGE E. STONE.

This department of investigation was established in 1888 and continued until 1892, when, on account of Dr. Humphrey's resignation, it was temporarily discontinued. Last July the department was re-established, and the physiological laboratory is now devoted to experimental work along the lines for which it was largely designed. Owing to the fact that the laboratory and its equipment were being used in other lines of investigation to the middle of September, experimental work in botany was necessarily delayed, and it was not until October that experiments were under way. At the present time, therefore, only a brief report can be offered. It may not be out of place, however, to state concisely some of the details relating to the line of work which is being pursued, reserving a fuller account of the experiments for subsequent publications.

The work of the division falls mainly under two heads, namely, vegetable physiology and vegetable pathology. The first occupies itself with a study of plant diseases, their prevention and cure. The second deals particularly with the function of the plant, whether normal or abnormal, and is concerned with the action of such external influences as heat, light, moisture, etc. It further endeavors to ascertain how far the utilization of these external influences is responsible for the inroads of fungi, and how far the fungi can be controlled by these physiological factors.

STUDY OF INJURIOUS FUNGI.

Throughout the entire year a large number of diseased plants is sent in for diagnosis. Work in this line must always be in progress, and the examination of these diseased forms occupies considerable time. Very frequently some of the diseases prove to be new, or at least little understood, and a study of them must be made for the purpose of gaining an accurate knowledge of their characteristics and habits, and thus enable us to treat them in an intelligent manner. It is highly important that the nature of every plant disease be fully understood before any attempt is made to treat it. Any attempt at treatment not based on knowledge is as unscientific as it is impracticable. Among the apparently new diseases occupying our attention at present are bacterial diseases of the strawberry and orchid, a begonia leaf disease, a stem disease of the cultivated aster and a rust on the blackberry. Besides these, observations are being made on a number of other more or less known fungi.

In connection with the study of injurious fungi, numerous tests are being made with new fungicides, especially with solutions which can be used in the greenhouse. These tests are first made directly on the spores in the laboratory, and then the solutions are applied to susceptible or diseased plants in the greenhouse. By means of such tests the effects of the solution on the spores can be readily observed, and the strength of the solution required for spraying can be tolerably well determined.

Nematode Worms.

No class of plants is more frequently sent in during the winter than greenhouse cucumbers affected with these worms, which completely riddle the tender tissues of the roots, much to the detriment of the plants. No satisfactory remedy has as yet been found, though various experiments are now being made in the greenhouse for the purpose of relieving the market gardener from these pests.

Beneficial Fungi (*Mycorhiza*).

It has been known in Europe for some years that the roots of many plants are covered with fungous growths, the predominance of which — in some instances, at least — is believed to have some bearing on the absence of root hairs. These facts, with other phenomena apparently of a similar nature which occur in the leguminosæ, etc., have led Frank * to surmise that these fungi play an important role in the assimilation of food material from the soil. As no investigations have been made to our knowledge on the occurrence of fungi on the roots of our native species of plants, Professor Smith and myself have devoted considerable attention during the past summer to work in this direction, for the purpose of determining, first, the prevalence of fungi on roots of our native plants; second, their nature and distribution; third, their relation to the absence of root hairs. Already a large number of plants have been examined, and it is proposed to carry on the investigations during the coming summer, with these additional points in view, — fourth, to prove by means of cultures whether the fungi are really essential to the plant in the assimilation of food from the soil; fifth, if proved, to throw some light, if possible, upon the process of assimilation; sixth, to ascertain whether these fungi are in any way — as Kerner maintains they are — accountable for the difficulty of transplanting certain plants.

Damping Fungi and their Relations to Temperature and Moisture.

Experiments are being made to ascertain the exact relations of the development of the damping fungi to temperature and moisture conditions. A large number of plants subject to damping off are being experimented with in a portion of the greenhouse provided with self-registering instruments. In connection with this line of work, experiments are being made to find out at what temperature the spores of injurious fungi common to the greenhouse commence to germinate. These experiments are undertaken for the purpose of learning to what extent certain diseases can be controlled by temperature and moisture conditions.

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* Lehrbuch der Botanik, page 295.

General Botanical Work.

Grass Collection.

Among the specimens sent in by farmers and other citizens of the State for determination are not infrequently grasses. The station possesses already a small collection of these most important plants, and it is hoped that in the course of time a representative of every species peculiar to Massachusetts will be found here, not only for our own use in aiding identification of obscure species, but for the benefit of the student and visitor who may wish to become familiar with them.

Weed Collection.

Any one who is conversant with our ever-extending commercial relations with foreign countries can realize that a considerable number of new species of plants reaches us every year. That most of these may prove perfectly harmless there can be no doubt; but, on the other hand, we do not know but that there is in our State to-day some slumbering pest, some unnaturalized immigrant, which may in a few years become as common as the daisy or shepherd's purse, and prove as disastrous as the Russian thistle. For this reason we wish to extend our collection of State weeds, and keep a careful record of the nature and time of introduction of every species. This department, therefore, requests the co-operation of all those interested in such matters, in its endeavor to make a complete collection and accumulate data bearing on the habits of our weeds.

REPORT OF THE AGRICULTURIST.

WILLIAM P. BROOKS.

Leading Results and Conclusions based upon the Experiments outlined in the Report of the Agriculturist.

Grass and Clover.

1. Nitrate of soda applied in early spring may safely be depended upon to produce a profitable increase in the first crop of hay, but such application will not materially increase the yield of rowen. The amount to be used is from 150 to 200 pounds per acre.

2. Muriate of potash applied to land which is to be seeded to mixed grasses and clovers may be depended upon to increase the proportion of clover in the produce, and consequently to make the hay more highly nitrogenous, and particularly to increase the yield of rowen. The amount needed is about 175 to 200 pounds per acre.

3. Fertilizers for top-dressing grass lands in spring should contain nitrate of soda and muriate or sulphate of potash; and, to benefit the rowen crop, they should contain also some slower-acting forms of nitrogen, such as sulphate of ammonia, dried blood, dry ground fish, bone meal or tankage. The fish, tankage or bone meal will furnish some phosphate, of which a moderate quantity will be useful.

Corn.

1. The application of muriate of potash has so invariably increased the yield of both stover and grain that the conclusion is irresistible that potash should be more abundant in fertilizers for this crop than is usually the case.

2. There is much evidence that the fertilizer for one acre should furnish at least 80 to 100 pounds of actual potash.

3. A corn fertilizer containing 5 per cent. of potash, applied at the rate of 1,000 pounds per acre, furnishes 50 pounds of actual potash. With such a fertilizer it will pay to use from 75 to 100 pounds of muriate of potash per acre.

4. Four cords of average farm-yard manure will supply about 96 pounds of actual potash; but not all of this will be available the first year, hence it will in most cases be found profitable to use with this manure 75 to 100 pounds of muriate of potash for corn.

Rye.

This crop is most largely increased by muriate of potash and nitrate of soda, but responds much less freely to an application of fertilizers than corn.

White Mustard.

1. In this we have a crop responding most freely to an application of phosphates, indicating that the percentage of phosphoric acid in fertilizers for turnips and cabbages (members of the same family) should be large.

2. White mustard sown yearly in standing corn in the later part of July grows until late in the fall, thus preventing soluble nitrogen compounds from being washed out of the soil. It does not injure the growth of the corn the year it is sown, and the ultimate effect is to make the soil produce larger crops in subsequent years.

Potatoes.

1. Both being used in connection with materials furnishing equal amounts of nitrogen and phosphates, sulphate of potash gives larger yields of potatoes than muriate of potash.

2. Used in the same way, sulphate of potash produces potatoes of better quality than muriate of potash.

3. Potato fertilizers should therefore contain potash in the form of sulphate rather than muriate.

4. A large share of a fertilizer for potatoes should be placed in the drill. This gives larger crops of better quality than spreading broadcast.

5. Treatment with solution of corrosive sublimate of seed potatoes which are moderately scabby will prevent scab, provided the germs of this disease are not present in the soil where the potatoes are planted.

Crimson Clover.

This clover has not proved hardy here, and experiments in its use should be tried upon a small scale.

Japanese Millets.

1. The "barn-yard" variety is worth a trial. Here it has yielded per acre: (*a*) seed, 66.7 bushels, and straw, 11,297 pounds; (*b*) green fodder, 18 tons; or (*c*) hay, 6 tons.

2. The green fodder is superior to good corn fodder in feeding for milk. It makes excellent silage.

Soja Beans.

The medium green variety is a useful crop, whether for feeding green or for silage. It will yield about two-thirds as much gross weight as corn; but is far richer in flesh formers. Silage made by mixing two parts of either corn or barn-yard millet with one of the beans makes a well-balanced feed for cows.

Flat Pea.

Seed was planted in the spring of 1894, but no fodder has as yet been produced.

Sacaline.

Seed planted in the spring of 1895 germinated well, the plants made a good start and promise a large yield of fodder next year.

Hay Caps.

A trial demonstrated their great usefulness in showery weather, and indicates that the Symmes' cap has much to recommend it.

Warming a Stable for Cows.

The increase in milk and butter due to warming a stable was small, and altogether insufficient to pay the cost.

Feeding Hens for Eggs.

1. Vegetable foods, even though furnishing equal amounts of all nutrients and in the proportions considered suitable, are shown to be much inferior to animal foods furnishing the same amounts of nutrients and in the same proportions.

2. Dried meat meal, everything being considered, appears to be superior as a feed for laying fowls to cut fresh bone.

SOIL TESTS.

Soil tests upon the plan agreed upon in convention in Washington in 1889 have been continued. During the past season we have carried out five such tests: two upon our own grounds, one with rye and the other with grass and clover as the crops; and one each in Concord, Hadley and Shelburne, with corn as the crop. The main points indicated are as follows: —

Grass and Clover.

1. Nitrate of soda, applied at the rate of 160 pounds per acre, is beneficial to the first crop of grass, the average increase amounting to 580 pounds per acre. This result is in line with all results in previous years, both here and elsewhere.

2. This application does not appreciably increase the rowen crop.

3. The potash greatly increases the proportion of clover, and thus considerably benefits the first cut of hay, the average increase this year amounting to 569 pounds of hay for an application of 160 pounds of muriate of potash per acre.

4. The effect of the potash application is most striking upon the rowen crop. This, where timothy, red top and clover are sown, is always chiefly clover. This year there was not rowen enough to weigh except where barn-yard manure or potash had been applied.

5. The phosphoric acid has not much affected either the first or the second cutting.

I would again recommend, for mowings containing mixed grasses and clover, as follows per acre: —

	Pounds.
Nitrate of soda,	150
Tankage of dry fish,	100
Plain superphosphate,	100
Ground South Carolina rock phosphate,	100
Muriate of potash,	150

Mix just before use and spread evenly in early spring.

Corn.

The soil tests with corn this year were all upon land which has been several years under similar manurial treatment. On Mr. Frank Wheeler's farm in Concord the work was begun in 1890, and his crops in the order of succession have been corn, corn, potatoes, grass and clover, grass and clover, and corn (1895).

On Mr. Wheeler's farm this year the average yield of the five nothing plats which have received neither manure nor fertilizer since 1889 was: stover, 3,956 pounds; grain, 40.6 bushels per acre. With muriate of potash alone, at the rate of 160 pounds per acre, the yield was: stover, 2,840 pounds; grain, 59.8 bushels. The average increase on four plats where potash was used, which is apparently due to this fertilizer, is: stover, 1,257 pounds; grain, 21.6 bushels. The average gain due to the use of nitrate of soda is 3.4 bushels of grain, that due to potash (dissolved bone-black) is 2 bushels.

On Mr. West's farm in Hadley the work was begun in 1890, and the crops have been corn, corn, oats, grass and clover, grass and clover, and this year corn. The average yield of the nothing plats per acre this year was: stover, 3,584 pounds; grain, 50.7 bushels. The increase apparently due to the application of potash alone was: stover, 2,900 pounds; grain, 27.4 bushels. The average increase on all plats where potash was used, apparently due to this element, was: stover, 3,200 pounds; grain, 22.8 bushels. Similar averages for nitrate of soda are: stover, 407 pounds; grain, 9.1 bushels. For phosphate (dissolved bone-black) there has been absolutely no average increase; the crops where this has been applied have been in fact a very little less in every instance except one where it has been used.

On the farm of Mr. Dole in Shelburne the soil test work was begun in 1889 and has continued seven years. The crops in order of succession have been corn, corn, potatoes, oats, grass and clover, grass and clover, and corn (1895). Shelburne is the only place in the State where soil test work with corn as the crop has been carried on which has not indicated potash to be most largely required. The results have been less decisive than in most places, but have indicated phosphate (dissolved bone-black) to be most useful in former years. The past season nitrate of soda appears to have been most useful to the corn crop; but there is strong reason for believing that Mr. Dole, in placing the unhusked corn in the barn, made mistakes in marking the several bunches of material; and I regret to say that the figures are such that I believe deductions therefrom would be unreliable.

Rye.

The acre upon our home grounds which has been seven years under soil test experiments has this year been in winter rye which was sown in October, 1894. In rye we have a crop with a long period of growth which is notable for its ability to extract its food from a poor soil. It was to be expected, therefore, that the differences produced by the fertilizer treatment would be less than with crops such as corn, potatoes and oats. This has been the case; but still the results speak in no uncertain tone. The succession of crops upon this acre has been corn, corn, oats, grass and clover, grass and clover, corn and rye. For the corn, the muriate of potash has been most useful; for the oats and grass, nitrate of soda; for the clover, muriate of potash. This season the average yield of the nothing plats has been: straw, 1,700 pounds; grain, 12.1 bushels. The muriate of potash alone has increased the straw 400 pounds, and the grain 4.1 bushels. On the average, the muriate of potash has produced the following increases, viz.: straw, 800 pounds; grain, 4.5 bushels. Neither the nitrate of soda nor the phosphate has been as beneficial. The muriate of potash is most beneficial when used with both nitrate and phosphate. The plat where all three were used produced an increase of: straw, 2,480 pounds; grain, 15.4 bushels, as compared with the nothings. Where manure at the rate of five cords per acre has been applied every year for seven years similar increases are: straw, 3,200 pounds; grain, 21.1 bushels. The grain raised on the fertilizer is better than that raised on manure, and in general the size and plumpness of berry were favorably affected by potash.

What White Mustard teaches.

Soon after the rye was harvested the land was ploughed and sown to white mustard, 40 pounds of seed being put in on July 31 without additional fertilizer. The result was a striking object lesson. Germination of the seed was quick and even, but, except on the plats where manure or phosphate (dissolved bone-black), lime and plaster have been applied, there was almost absolutely no growth. On the manure and "complete" fertilizer plats growth was characterized as good; on the plats receiving respectively nitrate of soda and dissolved bone-black, dissolved bone-black and muriate of potash, and dissolved bone-black alone, it was fair. On all others it was poor, though the plats which had received lime and plaster made a little better showing than the others. It will be noticed that where for seven years we have been applying phosphate — even with nothing else — the growth of the mustard was fair to good, while elsewhere there was very little growth; the plants simply vegetated, and then stood still. This result is especially significant upon this land, for, as shown in my description of the soil test with rye, dissolved bone-black has not very materially benefited either corn, oats, grass, clover or rye. On the same land, then, we find corn, clover and rye responding most freely to potash application; oats and grass, to nitrate of soda; and mustard, — a plant of an altogether different order (the turnip and cabbage family), — to phosphate. It is believed this object lesson indicates that here, as in England, where the fact has long been pointed out, fertilizers for turnips especially and probably for cabbages also should be rich in available phosphoric acid.

The fertilizers applied yearly in all the soil tests alluded to in my reports are shown in the table below. In some experiments there have been five instead of four nothing plats, as shown in this table, and the numbering of the plats has been different. In other particulars the plan in all has been identical. It has for its object not the production of large crops, but the discovery of facts concerning the special requirements of crops on the soils tested.

Applied Yearly per Acre.

No.	
1.	Nitrate of soda, 160 pounds.
2.	Dissolved bone-black, 320 pounds.
3.	Nothing.
4.	Muriate of potash, 160 pounds.
5.	Lime, 160 pounds.
6.	Nothing.
7.	Farm-yard manure, 5 cords.
8.	Nitrate of soda, 160 pounds. Dissolved bone-black, 320 pounds.
9.	Nothing.
10.	Nitrate of soda, 160 pounds. Muriate of potash, 160 pounds.
11.	Dissolved bone-black, 320 pounds. Muriate of potash, 160 pounds.
12.	Nothing.
13.	Land plaster, 160 pounds.
14.	Nitrate of soda, 160 pounds. Dissolved bone-black, 320 pounds. Muriate of potash, 160 pounds.

POTATO EXPERIMENTS.

Objects.

1. To determine whether the muriate or the sulphate of potash should be used as a source of potash in potato fertilizers.

2. To determine whether fertilizers for this crop should be applied broadcast and harrowed in or put into the drill.

Results.

1. Eight experiments, comparing the sulphate with the muriate of potash, have given an average of 22.1 bushels of merchantable tubers per acre more where the sulphate was the source of potash.

2. The eating quality of the tubers raised when the sulphate has been the source of potash has generally been better than when the muriate was used.

3. Analyses have generally shown that the tubers raised on the sulphate have contained less water and more starch than those raised on the muriate. When this has not been the case, it is believed to have been because the tubers had not properly ripened, owing to the premature death of the tops on account of blight.

4. There has been little difference in the appearance of the tubers raised on the two fertilizers, but the advantage is slightly with the muriate in this respect.

5. The number of bushels per acre in favor of the sulphate has ranged from 4.8 to 82.5 of merchantable tubers. In only one out of the eight experiments has the muriate excelled the sulphate; the difference on total yield was then only 28 pounds per acre.

6. The fertilizer in the drill has generally given larger crops than broadcast application. This has been the case in six out of the eight experiments, the range being from 12.5 bushels to 54 bushels of merchantable tubers per acre in favor of drill application. In the two experiments where broadcast application gave the larger crops, it is believed that the fact was due to natural inequality in the soil.

Details.

These experiments were begun in 1892, and have been continued every year. Each year we have had four plats, which we will call numbers 1, 2, 3 and 4. In 1892 and 1893 these plats were one-sixth of an acre each; in 1894 and 1895, one-fourth of an acre each. The fertilizers have each year been applied broadcast to plats 1 and 2; in the open furrow before dropping the seed to plats 3 and 4. Sulphate of potash has been the source of the potash each year on plats 1 and 3, muriate of potash on plats 2 and 4. The quantities of potash salts employed have been such as to supply equal numbers of pounds of actual potash to plats which were to be compared. Fertilizers supplying equal quantities of nitrogen and phosphoric acid to all the plats have each year been applied.

The experiments of 1892 and 1893 were upon the same land. This land had been in pasture for several years up to 1889. It was ploughed and planted in 1890 and 1891, the crops being white mustard, oats, soja beans and millets. The division into plats in the potato experiments ran across the rows of the two previous years, so that previous cultural conditions had been the same on all the four potato plats. The fertilizers applied in 1890 and 1891 comprised: nitrate of soda, 160 pounds; dissolved bone-black, 320 pounds; and muriate of potash, 160 pounds, per acre in each year. The soil of these plats is a fine medium loam, underlaid by gravel at the depth of about three feet, — an excellent soil, in so far as drainage, warmth and other physical conditions go, for the potato.

The land used in 1894 and 1895 was of the same general character, but with the gravel a little farther from the surface. The same field was used both seasons. This land had, previous to 1890, been used for several years as a pasture. From 1890 to 1893 inclusive it had been used for a variety of hoed crops, all raised on fertilizers. The conditions on all four plats had been alike, but from the nature of our results it is believed that the soil in Plat 4 is inferior in fertility to that in the other plats.

The kinds and amounts of fertilizers used per acre in each of the first three years are shown below: —

FERTILIZERS.	PLATS (1892).				PLATS (1893).				PLATS (1894).			
	1	2	3	4	1	2	3	4	1	2	3	4
Nitrate of soda (pounds),	160	160	160	160	240	240	240	240	240	240	240	240
Dry ground fish (pounds),	200	200	200	200	300	300	300	300	–	–	–	–
Dissolved bone-black (pounds),	250	250	250	250	375	375	375	375	375	375	375	375
Sulphate of potash (pounds),	174	–	174	–	261	–	261	–	211	–	211	–
Muriate of potash (pounds),	–	174	–	174	–	261	–	261	–	211	–	211
Tankage (pounds),	–	–	–	–	–	–	–	–	240	240	240	240
Dried blood (pounds),	–	–	–	–	–	–	–	–	60	60	60	60

In 1895 the same kinds and amounts of fertilizers were used on each plat as in 1894.

Manner of applying Fertilizers.

In every instance all the fertilizers to be used on a plat have been thoroughly mixed just before the seed was to be planted. On plats 1 and 2 each year all of the mixed fertilizers have been evenly spread after ploughing and at once harrowed in. On plats 3 and 4 the mixed fertilizer has been broadly scattered the full length of the open furrow in which the seed was to be dropped. In covering the seed the fertilizer was somewhat mixed with the soil and in part brought above the seed.

Seed used and Manner of Planting.

The variety of potatoes raised has every year been the same, — Beauty of Hebron. In 1892 the seed was from Aroostook County, Maine; in 1893 it was of our own raising; in 1894 all except that planted in four rows was from Maine, that in the four rows was of our own growing; and in 1895 all was from Aroostook County. In 1894 all the seed was treated with a solution of corrosive sublimate, for the prevention of scab. The treatment accomplished the object in view, and will be described later. Each year the seed has consisted of medium to large tubers, and it has been cut into pieces with two strong eyes each. It has been planted by hand in rows three and one-half feet apart and at a distance of twelve inches in the row. Planting has always been early.

Culture and Appearance while growing.

The land has been harrowed once before the seed was up, and later the harrow or Breed's weeder has been used once or twice more. The work thereafter has been carefully and seasonably performed with one-horse cultivators and hand hoes. During the early part of each of the four seasons the crop growing where the sulphate of potash had been applied was distinctly more vigorous and of a deeper color than that growing on the muriate. This difference was maintained throughout the season, but became less noticeable towards the close of the season of growth.

A similar difference in favor of drill application was always observed, also somewhat less marked towards the close of the season.

The crops of 1892 and 1893 were not affected by leaf blight to any great extent; but those of both 1894 and 1895 were affected, and as a consequence the tubers were less perfectly matured in those years.

Yields per Acre (Bushels).

Sulphate of Potash.

1892. Broadcast, merchantable tubers, 185.7; small tubers, 10.8.
Drill, merchantable tubers, 192.5; small tubers, 13.5.
1893. Broadcast, merchantable tubers, 290.4; small tubers, 26.4.
Drill, merchantable tubers, 344.4; small tubers, 15.0.
1894. Broadcast, merchantable tubers, 248.0; small tubers, 20.0.
Drill, merchantable tubers, 268.4; small tubers, 17.2.
1895. Broadcast, merchantable tubers, 241.5; small tubers, 15.3.
Drill, merchantable tubers, 260.4; small tubers, 14.0.

Muriate of Potash.

1892. Broadcast, merchantable tubers, 166.6; small tubers, 13.3.
Drill, merchantable tubers, 179.0; small tubers, 17.0.
1893. Broadcast, merchantable tubers, 285.6; small tubers, 15.0.
Drill, merchantable tubers, 325.6; small tubers, 21.0.
1894. Broadcast, merchantable tubers, 254.4; small tubers, 14.3.
Drill, merchantable tubers, 186.4; small tubers, 11.3.
1895. Broadcast, merchantable tubers, 234.0; small tubers, 16.6.
Drill, merchantable tubers, 222.7; small tubers, 13.5.

An examination of the figures for corresponding years and plats reveals the fact that the plats receiving sulphate of potash have given the largest yield in every instance except one, viz., broadcast application in 1894. The averages for the two potash salts are as follows: sulphate of potash, per acre, merchantable tubers, 253.9 bushels; small tubers, 16.5 bushels; muriate of potash, per acre, merchantable tubers, 231.8 bushels; small tubers, 15.25 bushels. The average difference amounts to 22.1 bushels of merchantable tubers and 1.25 bushels of small tubers. The difference in cost between the two potash manures amounts to about two dollars per year, the sulphate costing the more.

It should be remarked that since some adverse influence, previously alluded to (not connected with the system of manuring), has affected the crops upon Plat 4 during 1894 and 1895 (drill application of muriate of potash), the above average difference in favor of the sulphate of potash is undoubtedly too large. If we leave this plat out of the calculation, the average difference in favor of the sulphate of potash amounts per acre to merchantable tubers, 13 bushels; small tubers, .3 bushels.

Comparison of the yields on plats receiving the same fertilizers in the different years shows that drill application has given the larger yield in all cases except where drill application of the muriate of potash is compared with broadcast application for 1894 and 1895. As previously stated, Plat 4 (muriate of potash in the drill) has evidently suffered from some inherent inequality in conditions. It therefore seems best to disregard the results of muriate of potash for the seasons 1894 and 1895 in estimating the relative merits of the two systems of application. On this basis the average difference in favor of drill application amounts per acre to 23.5 bushels of merchantable tubers.

Quality of the Crops.

In each year, soon after digging, samples of potatoes grown respectively on sulphate and muriate of potash have been sent under numbers with no other information to several families, who were requested to use them and report whether there was any difference in quality. In 1892 all reported that the potatoes grown on the sulphate were whiter, more mealy and better flavored than the others. In 1893 they all reported that they could see no great difference between them. In 1894 and 1895 the potatoes grown upon the sulphate were with one or two exceptions reported to be superior to those grown on the muriate, in color, mealiness and flavor. Those reporting otherwise stated that they could see no great difference. In 1894 the head of one family said: "If you have potatoes like No. 1 [grown on sulphate] I would like to get my winter's supply of you; but I would not take No. 2." The season of 1893 was exceptionally hot and dry, as was also that of 1894; but the soil used in 1894 was deeper, and the crop suffered comparatively little from drought.

Moisture and starch determinations in samples of potatoes grown respectively on the sulphate and the muriate have been made every season. The results are shown below for the first three years. They are not given for the present season, because but two samples were taken: one the muriate potatoes, where the fertilizers were put on broadcast; the other the sulphate potatoes, where the fertilizers were put in the drill.

		Sulphate of Potash Potatoes.		Muriate of Potash Potatoes.	
		Water (Per Cent.).	Starch (Per Cent.).	Water (Per Cent.).	Starch (Per Cent.).
1892	Broadcast, ...	81.09	10.66	81.33	11.99
	Drill, ...	81.56	10.98	81.83	9.45
1893	Broadcast, ...	75.56	16.98	81.99	12.52
	Drill, ...	74.40	18.44	78.98	14.11
1894	Broadcast, ...	78.01	15.98	77.53	16.03
	Drill, ...	78.18	15.75	77.68	16.28

It will be noticed that in three out of the six possible comparisons the percentage of water is less and that of starch is greater in the potatoes grown on the sulphate of potash, and that the differences are considerable. In those cases where the results were favorable to the muriate, the differences as a rule are small. The averages for the two fertilizers are: sulphate of potash potatoes, water, 78.11 per cent.; starch, 14.99 per cent. Muriate of potash potatoes, water, 79.86 per cent.; starch, 13.68 per cent.

In those seasons when the muriate potatoes have compared most favorably with the sulphate potatoes, the crop has suffered from leaf blight, and has not therefore ripened as well as in other seasons. It is believed that the experiments indicate that, under average conditions of soil, season and ripening, the potatoes grown on the sulphate of potash will contain less water and more starch than those grown on the muriate.

Examination of the above table shows also that the potatoes grown under drill application of the fertilizers have usually been superior in quality to those grown where the fertilizers have been put on broadcast, containing less water and more starch. The most marked exception is on muriate of potash in 1892; but it appears not unlikely that there was an error in the analysis, since the proportion of water in the drill potatoes is nearly the same as in those grown where the fertilizers were broadcast. It will be noticed that elsewhere the variations in water and starch are about equal in amount, but in opposite directions. When there is more water there is less starch, and *vice versa*. Leaving out the muriate plats for 1892, the averages are: for drill application of fertilizers, water, 78.2 per cent.; starch, 14.9 per cent. Broadcast application of fertilizers, water, 78.8 per cent.; starch, 14.4 per cent.

It is undoubtedly the better ripened condition of the tubers raised under drill application which accounts for their superiority.

Maine compared with Home-grown Seed.

In 1894 Houlton seed in quantity supposed to be sufficient for the entire area under experiment was obtained. It proved insufficient, and the last four rows in each of the four plats were planted with seed grown upon the farm the previous year. These potatoes were raised from Houlton seed. The season of 1894 was, therefore, the first removed from the Maine stock. The results were decidedly in favor of the Houlton seed. The plants started quicker and more vigorously, and maintained their superiority throughout the entire season. At harvest the superiority of the crop from the Houlton seed was marked. Each kind was separately weighed on each plat. On Plat 1, Maine seed yielded at the rate of 399.5 pounds more than home seed; on Plat 2, 454 pounds more; on Plat 3, 605.5 pounds more; on Plat 4, 548 pounds more. Per acre the difference in favor of Maine seed amounted to 36.5 bushels, — far more than enough to repay the usual difference in the cost of the two kinds of seed.

Treatment of Seed with Corrosive Sublimate.

In 1894, as the seed to be used showed a little scab, it was all treated with corrosive sublimate solution. Two and one-fourth ounces of corrosive sublimate were dissolved in fifteen gallons of water. The seed was at first washed with a hose, being spread in a shallow inclined trough. After draining, the seed was put into the solution and allowed to remain one and one-half hours. It was then taken out, spread and allowed to dry in the sun, being cut and planted about as soon as it was dry. Corrosive sublimate can be purchased of druggists. It is a dangerous poison if taken into the stomach, but it is not at all dangerous to handle the seed thus prepared. The same solution can be used several times if all the seed cannot be put in at once. Care should be taken to use wooden vessels for the solution, as it will corrode metals. After use the solution should be thrown away in such a manner as to make it certain that animals cannot get hold of it, and where it cannot contaminate wells, springs, streams or ponds.

The treatment is effective in preventing scab where the germs of the disease are not present in the soil, — *i. e.*, on land where scabby potatoes have not been grown for several years. The method was perfected by Professor Bolley of North Dakota, and is fully described in Bulletin No. 9 of that station.

Variety Tests of Potatoes.

Sixty-five varieties of potatoes have been grown during the past season. With few exceptions we procured three pounds of seed of each variety. This seed came from many different sources and was of very varied quality and excellence, both as regards original characteristics and conditions as affected by keeping and transportation. It is not believed that with seed of the different varieties of such unlike character it is possible to make comparisons of permanent value between the varieties. We now have a supply of seed of each sort raised by ourselves under precisely the same conditions. It will be kept and managed alike for all varieties. With such seed to start with, and planted under appropriate conditions, we shall obtain results of value for purposes of comparison.

Meanwhile the following details will be of interest, as illustrating to what an extent the crop is influenced by the seed. The seed of all varieties was cut into pieces of two eyes each, with a very few exceptions where this would have made the pieces extremely small. One row of each sort was planted. Its length was forty feet, the pieces being placed twelve inches apart in the row. The distance between the rows was uniform, three and one-half feet. With the exception of two or three sorts which arrived late, all kinds were planted on the same day. The tops of all were prematurely killed by the blight due to *Macrosporium*, and at about the same time. Full notes have been put on record regarding peculiarities in growth, and the character of the crop harvested. The yield of each has been recorded, — it varies from 24½ to 71¼ pounds merchantable potatoes. Six varieties gave a total yield of more than 60 pounds, twenty-three varieties between 50 and 60 pounds, seventeen varieties between 40 and 50 pounds and sixteen varieties between 30 and 40 pounds. The balance gave under 30 pounds total yield. A yield of 60 pounds is equivalent to about 315 bushels per acre. The best variety, then, yielded at the rate of about 368 bushels of merchantable tubers per acre, the poorest at the rate of about 125 bushels.

The soil was a medium, well-drained loam. It received a dressing of manure in December, 1894, at the rate of 7 cords per acre. We used fertilizers, mixed and applied in the drill at the following rates per acre: —

	Pounds.
Nitrate of soda,	120
Dissolved bone-black,	187½
Sulphate of potash (high grade),	105½
Tankage,	120
Dried blood,	30

MANURE ALONE *v.* MANURE AND POTASH FOR CORN.

The experiment to test the value of manure and potash as compared with a larger quantity of manures alone for the corn crop has been continued, the past being the fifth successive year of similar treatment. Where manure alone was used we applied at the rate of 6 cords per acre, spread after ploughing and harrowed in. The manure and potash similarly applied have been put on at the rate of 4 cords of the former and 160 pounds of muriate of potash for the latter. The plats, four in number, contain one-quarter of an acre each. The results are shown below: —

Plat No. 1, manure, stover, 1,367 pounds; corn on the ear, 1,227 pounds
Plat No. 2, manure and potash, stover, 1,223 pounds; corn on the ear, 1,065 pounds.
Plat No. 3, manure, stover, 1,025 pounds; corn on the ear, 1,266 pounds.
Plat No. 4, manure and potash, stover, 987 pounds; corn on the ear, 1,160 pounds.

The manure used was made by cows, that applied to Plat 4 being not as good as that applied to the other plats.

The application made furnished plant food at the following rates per acre: —

FERTILIZERS.	Nitrogen (Pounds).	Phosphoric Acid (Pounds).	Potash (Pounds).
Plat 1, manure alone,	126.4	99.9	232.2
Plat 2, manure and potash,	96.2	67.5	260.8
Plat 3, manure alone,	109.1	100.3	217.8
Plat 4, manure and potash,	83.8	90.4	224.6

It will be noticed that where manure alone was applied considerably more nitrogen and phosphoric acid have been supplied than on the other plats, while the quantity of potash also is large. It will not be wondered at that after five years of such treatment these manure plats are yielding larger crops than those receiving smaller amounts of manure and potash. The average difference in favor of the manure alone this year is at the rate of 6.8 bushels of grain and 364 pounds of stover per acre, — not enough to cover the larger cost of the manure, as compared with the cost of the lesser amount of manure and the potash. The crop per acre is worth this year $4.17 more when manure alone was applied; but the 6 cords of manure must be reckoned as costing $6.80 more than the 4 cords of manure and the 160 pounds of muriate of potash.

Special Corn Fertilizer v. Fertilizer containing More Potash.

Many soil tests in different parts of the State having indicated that fertilizers for corn should contain a larger proportion of potash, an experiment in continuous corn culture was begun in 1891. There are four plats of one-fourth of an acre each, on two of which the "special" furnishes the amounts of nitrogen, phosphoric acid and potash that would be supplied by the application of 1,200 pounds of a fertilizer having the average composition of all leading kinds offered in our markets in 1891.

The materials used are shown below: —

FERTILIZERS.	Plats 1 and 3 (Pounds).	Plats 2 and 4 (Pounds).
Nitrate of soda, ...	55½	33
Dissolved bone-black, ...	213	112½
Muriate of potash, ...	27	75

The yields the past year are shown below: —

Plat 1, "special" fertilizer, stover, 1,092 pounds; grain on ear, 1,112 pounds.

Plat 2, fertilizer richer in potash, stover, 1,199 pounds; grain on ear, 1,055 pounds.

Plat 3, "special" fertilizer, stover, 958 pounds; grain on ear, 1,220 pounds.

Plat 4, fertilizer richer in potash, stover, 1,100 pounds; grain on ear, 1,190 pounds.

Computed to the acre and the grain in bushels, the averages are: "special," stover, 4,100 pounds; grain, 58.3 bushels; fertilizer richer in potash, stover, 4,598 pounds; grain, 56.1 bushels. Here, as in the comparison between "manure" and "manure and potash," there is rather more stover and a little less grain where the greater amount of potash is used. The "special" produces this year, per acre, 2.2 bushels more grain and 498 pounds less stover than the combination with more potash. The increase in stover due to the greater amount of potash is worth about $1.10 more than the increase in grain due to the "special;" hence, as the fertilizer richer in potash costs about $2.52 less per acre than the special, there is a net advantage amounting to $3.62 per acre in favor of the former.

It is believed that by *the introduction of plants of the clover family* (*nitrogen traps*), which from experiments here and in many other places we are justified in concluding would grow more luxuriantly where the larger amount of potash has been used than where "special" has been applied, the advantage of the larger potash application could be much increased. An effort to demonstrate this fact has been made in each of the seasons of 1893 and 1894 by sowing *crimson clover* on one-half of this acre; but, owing to the *winter-killing* of this *clover* both years, the effect, though favorable, is small. Per acre the yields have been: where crimson clover was sown, stover, 4,512 pounds; grain, 58.6 bushels; without clover, stover, 4,186 pounds; grain, 55.9 bushels. The clover has been sown in the standing corn in July, and turned under just before planting the corn the following spring.

HILL *v.* DRILL CULTURE FOR CORN.

On plats 1 and 2 in both the corn experiments just described the corn was planted in drills; on plats 3 and 4, in hills. We have left equal numbers of plants to a plot in both systems. All rows were three and one-half feet apart; hills with three plants each, three feet apart; plants in the drill one foot apart. In both experiments the hill system has produced rather more grain and less stover than the drill. The average figures per acre are as follows: manure *v.* manure and potash, hills, stover, 4,024 pounds; grain, 60.7 bushels; drills, stover, 5,180 pounds; grain, 57.3 bushels; "special" *v.* fertilizer richer in potash, hills, stover, 4,116 pounds; grain, 60.3 bushels; drills, stover, 4,582 pounds; grain, 54.2 bushels. Averaging both experiments, the drill system produced the more valuable *total* crop.

White mustard as a crop for nitrogen conservation has been sown on one-half of the acre of corn where *manure alone* is compared with *manure and potash* every year since 1892. The mustard seed is sown in the standing corn in July, at the rate of 24 pounds per acre. Its growth from year to year has varied greatly, as in very dry seasons it does not start well. The past two seasons the growth has been light. It is ploughed in late in the fall. The beneficial effect is apparent, and is doubtless largely due to the fact that the mustard, which grows till very late in the season, prevents in a measure the loss of soluble nitrogen compounds by leaching. It acts as a *nitrogen conserver*. The averages this year per acre are as follows: with white mustard as a green manure, stover, 4,828 pounds; grain, 61.7 bushels; without the mustard, stover, 4,376 pounds; grain, 56.3 bushels. *Gain by green manuring*, stover, 452 pounds; grain, 5.4 bushels.

JAPANESE MILLETS.

Panicum crus-galli.

The Japanese millet of this species, which I propose to call "barn-yard" millet, because it is of the same species as the common barn-yard grass, has been very thoroughly tried the past year, for seed, for green fodder and for hay.

For Seed. — For seed purposes we raised about three-quarters of an acre. The land, in very moderate fertility, was manured at the rate of 6 cords per acre of good manure in December, 1894, and after ploughing this spring the following materials per acre were spread on (mixed) and harrowed in: nitrate of soda, 100 pounds; dissolved bone-black, 200 pounds; and muriate of potash, 100 pounds. The seed was put in with a small seed sower, in drills fifteen inches apart. It was wheel-hoed, and kept free from weeds. The crop was very even, averaging seven feet in height. The yield was at the rate per acre: straw, 11,297 pounds; and seed, 66.7 bushels.

For Green Fodder and the Silo. — Several pieces of an acre or more each were sown for feeding green or for the silo. The earliest, sown broadcast about the middle of May on rich land, one peck of seed to the acre, averaged about six feet in height and produced over 15 tons per acre. This was cut from day to day, beginning before the millet had blossomed. Another field of about an acre, sown the last of June, yielded at the rate of rather over 18 tons per acre. Another field, sown July 26, after a crop of hay was removed, yielded about 12 tons per acre. The crop of the two last fields was put into the silo. That cut from day to day and fed green to cows was much relished. Its superiority to well-eared flint corn fodder was very apparent. Cows with both before them always take the millet first; they consume it without waste, while they are apt to leave a part of the stalks of the corn as it approaches maturity. In alternating this feed with corn fodder, the cows invariably increased in milk when put upon the millet and fell off when changed to corn.

It has been ensiled with soja beans, — about two parts by weight of the millet and one of the beans. This combination makes very superior silage.

For Hay. — A more extensive trial of this millet for hay has been carried out this year than ever before. It is coarse and difficult to dry. I have always felt that these qualities would render it undesirable as a crop for hay. We have, however, cured it successfully this year, mostly in small cocks, as clover is often cured; and the result is encouraging. The hay is coarse, but is freely eaten by horses, being preferred to a good sample of timothy, red top and clover mixture. The yield of the millet is very large, having on good land amounted to 6 tons per acre of well-cured hay. It will produce a fair second cutting if sown early in May and cut when in blossom.

The soil best for this millet is one that is rather retentive and rich. It stands up remarkably well, notwithstanding its great height. From a peck to a half bushel of seed, according to the richness of the land and the season of sowing, is enough. Less seed the richer the land and the earlier the season should be the rule. This millet will not endure drought well, except it be sown early in retentive soil. From early corn-planting time to about July 1 will usually be the limits of season for profitable sowing.

Panicum miliaceum.

This species, some other varieties of which are known as "panicle," "broom-corn" and "French" millets, I shall speak of hereafter as "Japanese panicle" millet. It has been grown upon a small scale for seed the past year. The area was a little less than a quarter of an acre. It received at the rate per acre: nitrate of soda, 175 pounds; dissolved bone-black, 320 pounds; and muriate of potash, 175 pounds, — all mixed, sown broadcast and harrowed in. The seed was thinly sown in drills, fifteen inches apart, and cultivated and kept free from weeds. The yield was at the rate of: straw, 5,856 pounds; seed, 34.1 bushels per acre. This variety is liked for fodder by some who have tried it; but I regard it as inferior to the barn-yard millet for that purpose. The seed is valuable for poultry and birds.

Panicum italicum.

The Japanese variety of this species has been grown for seed; soil, manure and fertilizers, as well as manner of planting and care, the same as for "barn-yard" millet. It yields at the rate per acre: straw, 3,836 pounds; seed, 66.4 bushels. This variety is of value for fodder, but I prefer the "barn-yard" variety.

VARIETY TESTS WITH MILLETS.

Twenty-seven varieties of millet have been grown upon a small scale, for purposes of comparison. With three exceptions four rows, each thirty feet long, were planted. Of these, owing to our inability to procure enough seed, we had but one or two rows. Careful observations have been put on record, but only for preliminary purposes, as the scale of work was small. The gross yield varied from 11 to 49 pounds. Six varieties yielded above 40 pounds; six, from 30 to 40; seven, from 20 to 30; and eight, between 10 and 20 pounds. Four varieties, "White French," "broom corn," "hog" and "California," appear to be identical. The "pearl" millets are too late to perfect seed here. The Japanese (*italicum*) excelled either the "golden" or the "golden wonder."

Variety Tests with Turnips.

Preliminary tests have been made with thirty-two varieties of turnips. There were among the number numerous kinds which appear to differ from others only in name, and there was a wide difference in yield and quality. Further work must be done before reporting details.

Soja Beans.

Early White. — Grown for seed; area, .49 acre; yield, 18¼ bushels per acre. This variety is too small for fodder. It ripens as surely here as our common field corn. The beans ground are slightly superior in feeding value, for milk, cream or butter, to cotton-seed meal, but the yield is rather small. The cultivation costs about the same as that of corn for equal areas. The vines shed their leaves before the pods are ripe, and hence they have very little feed value. The manurial value of the straw is about $2.40 per ton.

Medium Black. — This variety, though later than the above, has ripened here every year for the last seven. It has been grown this year both for seed and for the silo. For seed: area, .6 acre; yield, 14 bushels per acre. This variety rusted somewhat this year. We put the product of .45 acre into the silo, mixed with about two parts by weight of barn-yard millet. The yield was at the rate of 12,922 pounds per acre. This crop stood about three and one-half feet high. It is better for fodder than the early white, but appears to be much inferior to the medium green variety for that use.

Medium Green. — This variety is a little later than the last. It has ripened every year until this without injury.

This year it was somewhat injured by frost; but we have nevertheless secured a very good crop of seed. Area for this purpose, .6 acre; yield, 14 bushels per acre. We put the product of .45 acre into the silo with millet, as just described. The crop averaged nearly four feet in height, and was heavily podded. The yield was 20,644 pounds per acre. I look upon this as a very valuable fodder variety, either for feeding green or for the silo. It is a rich nitrogenous feed, and (of great importance) it can take much of its nitrogen from the air. Its roots here are very thickly covered with tubercles containing the bacilli which give it this power. For comparison, I give figures showing the analysis of this bean fodder and those for corn fodder: —

	Per Cent.
Medium green soja bean, pods formed, but not hardened, dry matter,	30.16
Longfellow corn fodder, ears glazed, dry matter, ...	27.81

Composition of Dry Matter (Per Cent.).

	Protein.	Fat.	Cellulose.	Carbohydrates.
Medium green soja bean, . .	19.35	3.87	23.51	40.30
Longfellow corn fodder, . .	9.79	3.26	18.27	63.11

The protein is classed as a flesh former, the other substances above named are fat and heat producers. The flesh formers and the fat of fodder are the most valuable of these constituents, pound for pound; the cellulose or fibre is the least valuable. On the farm here our average yield of corn fodder is about 16 tons per acre, while the green soja bean gave this year a little over 10 tons. The amounts of the different food constituents produced are as shown below: —

Food Constituents per Acre (Pounds).

	Flesh Formers.	Crude Fat.	Fibre.	Fat and Heat Producers.
Green soja bean, ...	1,167.2	233.4	1,418.1	2,430.9
Longfellow corn, ...	871.3	290.1	1,626.0	5,616.8

It will be noticed that the bean produces about 300 pounds more flesh formers than the corn, but that the latter gives us over 3,000 pounds more fat and heat producers. These consist chiefly of starch and sugar, both of which are easily digested and valuable foods. The differences in crude fat and in fibre are much smaller, but the balance is slightly with the corn. There can be no doubt, then, that the latter produces the more valuable crop of the two, and the cost of production for equal areas does not differ very materially. In three respects, however, the bean is superior to the corn; viz., (1) it can draw much of its nitrogen from the air; (2) the bean stubble and roots probably have greater manurial value than those of corn; and (3) the bean, being so rich in flesh formers, may take the place of such concentrated foods as cotton-seed meal, linseed meal, gluten meal, etc.

Silage made from either barn-yard millet or corn and medium green soja bean, in the proportion by weight of about two parts of either of the two former to one of the latter, makes a perfectly balanced ration for milch cows, without grain or other feed of any kind. It is not believed that it would be advisable to feed altogether upon this material, for cows like variety, and it is possible that continuous use of a fermented feed like silage would have a prejudicial influence upon health. A combination of such silage and clover hay or clover rowen — about two parts of the silage to one of the hay by weight — would, I believe, give good returns in milk. This particular system of feeding has not yet been tried here.

MISCELLANEOUS CROPS.

We have had under trial a number of miscellaneous crops, including *Cystisus proliferous albus*, a new fodder plant sent on for trial by J. M. Thorburn & Co.; yellow millo maize, from the United States Department of Agriculture; two varieties of dent corn, from South Dakota; black barley; spring wheat, from South Dakota; horse bean; sacaline; flat pea and the mummy field pea. None require extended notice at present.

Cystisus (no common name is given) vegetated slowly and made a slow growth. It appears to be hardy, remaining green until November 5, when it was three feet high, with small and woody stalks. It has produced no fodder as yet.

Yellow millo maize is a sorghum, and, like all other varieties of this species, grows slowly at first. Planted with corn, it was eight to twelve inches high when corn was thirty. It has the reputation of enduring drought well; but our seasons are not long enough for it, and I consider it of no value as a fodder crop here.

One of the dent corns from South Dakota appears to be a very valuable sort. It is a white variety. The seed of but two ears was planted, and upon soil of very ordinary fertility. The stalk is short and small, the ears large and deep kernelled, the variety early. The yield was at the rate of 89.6 bushels of grain to the acre.

The *spring wheat* and *black barley* did poorly, rusting and giving very small returns.

Horse Bean. — We received one peck of seed from a dealer in Montreal. It was planted in drills eighteen inches apart, in deep, clayey, rich soil, on April 29. The growth was vigorous and healthy, but few pods formed. The height was from four and one-half to five feet. It was cut from day to day, beginning July 17, and fed to cows, being highly relished. The total weight was 2,035 pounds, or at the rate of a little over 12 tons per acre. This yield of so highly nitrogenous a fodder makes it of possible value.

Sacaline. — Seed was procured of Gregory & Son of Marblehead, and sown in a bed in the open air April 23. The germination was slow, but good. Early in July the little plants were taken up and reset about three inches apart each way. About the middle of August plants were set in the field three feet apart each way. Two widely different soils were selected, — one a heavy, rich, moist loam, the other a dry, sandy loam. The plants in both soils lived well, and those in the moist, rich land made considerable growth, though not enough to be worth harvesting. A few stems cut and offered to cattle were freely eaten. The plant is perennial, and should next season produce considerable fodder which may prove valuable for green feed or for the silo.

Flat Pea. — The past is our second season with this much-lauded fodder plant. The germination last year was slow and imperfect. This year the plants have been gathered upon a lesser area, some being taken up to fill vacancies on the part left. The soil is light and dry. We have in the two seasons been at a very considerable expense, and as yet have no fodder; but, as the plant is perennial, this may come later. It is hardy with us upon light soil.

Mummy field peas are larger than the common Canada field pea, and about one-fourth to one-half more seed should be sown. We used at the rate per acre of one bushel of each with two bushels of oats for fodder. The mummy variety was not thick enough. In one respect it appears superior to the Canada; viz., it lodges less. This difference may, however, have been in part due to the fact that the mummy variety was the thinner in the field. The yields of the two fodder mixtures, as determined by calculation based upon small equal areas, were: oats and Canada pea, 21,760 pounds, and oats and mummy pea, 19,040 pounds, per acre.

Trial of Hay Caps.

Three kinds of hay caps have been subjected to careful comparative tests. The kinds tried were the Symmes' paper-board cap, oiled cotton, and cotton impregnated with tannin. The first was not fastened in place, its weight and construction rendering this less necessary than for the other forms. It, however, sometimes blew off in high winds. The others were fastened on by means of pins attached to cords at the corners.

Three trials were made, two with clover rowen which had been dried one day, and one with barn-yard millet which had been dried three days. After the caps were put on the first trial continued seven days; the second, two days; the third, with millet, seven days. During each trial there were one or more showers. In every trial the use of the cap was very beneficial. The paper cap excluded the rain most perfectly, and the hay in each trial came out in best condition. There was not much difference in the condition of the hay under the other two kinds of caps. As the

Symmes' paper cap can be put on fully twice as rapidly as the forms requiring fastening, it appears to be most useful. Its weight is an objection, and of course we are not yet able to report upon durability.

Experiment in Warming a Stable for Cows.

This experiment was continued during the winter of 1894–95, beginning December 18 and continuing until March 8. It will be remembered that our stable has two similar wings, one piped for hot-water heating. We aimed to maintain a temperature of about 55° F. in the warm stable. The other, of course, varied with the weather; but, as both stables are thoroughly constructed, even the "cold" side was seldom excessively cold. Six cows were used in the experiment, three on each side. We divided the time into four periods of equal length. At the close of the first period the cows changed stables. Here they were kept for two periods, and were then changed again. In this way we equalized conditions for the two stables. Between periods, when a change in the position of the cows was made, we allowed an interval of one week, that the animals might become accustomed to and under the influence of their new quarters before the records were begun.

The apparent influence of the warm stable upon milk and butter fat production is small. On the average, there is rather more milk and butter fat in the warm stable. The most certain effect brought out by our experiments is the lowering of the percentage of fat in the milk in the warm stable. The increased product will not nearly pay the cost of heating the stable.

With moderate artificial heat better ventilation can be secured, without making the stable too cold for the comfort of its occupants, than is possible without artificial heat. This should have an ultimate influence upon health; but the tuberculin test, as well as physical examination, indicated all our animals to be in perfect health at the close of the experiments, hence we as yet have nothing conclusive upon this point.

POULTRY EXPERIMENTS.

These have been upon a small scale, on account of location and limited equipment. We have had four coops of laying fowls, raised in 1894. There have been from fifteen to nineteen hens in a house. The houses are exactly alike in construction, each with nesting and laying room, ten by twelve feet; and scratching shed, eight by ten feet in size. The hens were of two breeds, — light Brahma and barred Plymouth Rock.

We have confined our attention to two points: —

1. The relative value for egg production of vegetable as compared with animal substances for furnishing the greater part of the albuminoids and fats of the food.

2. The relative value for egg production of animal food in the form of dried "animal" or "flesh" meals, as compared with cut fresh bone.

1. *Vegetable v. Animal Albuminoids.*

Two experiments have been carried out: one extending from Dec. 9, 1894, to Feb. 12, 1895; the other from June 1 to Oct. 31, 1895. The first experiment began when the fowls were pullets, hatched in May; the second includes a considerable proportion of the time occupied in the annual moult. These facts account in part for the small egg production. During the summer experiment the fowls had the run of small grass yards.

The material used in the first experiment to furnish the vegetable substitute for animal food was soja-bean meal. This is an exceptionally rich vegetable substance, in composition excelling meat meal, as will be seen from the figures below: —

Composition of the Dry Matter, Soja-bean Meal and Meat Meal (Per Cent.).

FOOD.	Flesh Formers.	Fat.	Heat and Fat Formers.
Soja-bean meal, ...	34.37	16.38	45.22
Meat meal, ...	35.98	8.31	–

Moisture: soja-bean meal, 11.61 per cent.; meat meal, 13.68 per cent.

In the second experiment linseed and cotton-seed meal were used as the vegetable substitutes for animal foods.

In both experiments the fowls received a variety of foods, but the nutritive ratio was always kept substantially the same for the two coops under comparison. In the first experiment the ratio was one flesh former to four and one-half fat and heat formers; in the second it was one to four and seven-tenths. The foods used in the first experiment, in addition to the soja-bean meal and meat meal, were: cut alfalfa, wheat, oats and middlings in one coop; in the other, boiled potatoes, ground clover, wheat, wheat middlings and cut bone.

In the second experiment the supplementary feeds were: wheat, oats, bran and middlings for the vegetable coop; and wheat, oats, wheat meal, bran and linseed meal for the animal food coop.

Both coops had pure water, artificial grit and ground oyster shells always before them; and all other conditions were made as nearly as possible alike.

The result in both experiments has been favorable to the animal food, as shown by the following summary: —

Vegetable v. Animal Foods for Hens.

FOOD.	Duration of Experiment (Days).	Daily Cost per Fowl.	Number of Eggs.	Water-free Food per Egg (Pounds).	Cost per Egg.
Vegetable food, first coop, .	64	$0 0021	11	23.830	$0 3410
Vegetable food, second coop,	153	0027	400	.917	0150
Animal food, first coop, . .	64	0024	79	3.554	0550
Animal food, second coop, .	153	0033	622	.773	0115

In the above estimate of cost no charge is made for labor and no allowance for the droppings. The production of eggs is, of course, very small, even in the best period; but it should be remembered that, at the very time when hens always lay most freely, our fowls were taken out of this experiment for breeding purposes, viz., from February 12 to June 1.

The results are, however, decisive against the vegetable food and in favor of the animal in so far as effect upon egg production is concerned. The fowls receiving animal food were, moreover, in much better condition at the close of these experiments than the others.

2. *Dried Animal or Meat Meal compared with Cut Fresh Bone.*

There were two experiments. The general conditions were the same as in the comparison of vegetable and animal foods. The nutritive ratio was nearly the same in coops compared. A variety of foods was supplied; artificial grit and oyster shells were given *ad lib.* The results are shown below: —

FOOD.	Duration of Experiment (Days).	Daily Cost per Fowl.	Number of Eggs.	Water-free Food per Egg (Pounds).	Cost per Egg.
Dried meat meal, first coop, .	64	$0 00266	185	1.185	$0 0170
Dried meat meal, second coop,	153	00280	417	1.051	0152
Cut fresh bone, first coop, .	64	00248	163	1.154	0170
Cut fresh bone, second coop, .	153	00300	444	.978	0143

These results are rather indecisive, as in one experiment the meat meal and in the other the cut fresh bone gave the better results, as measured by egg production. The condition of the fowls receiving the meat meal has, however, been uniformly better than in the other coops. There has been no diarrhœa. In the second experiment, two hens in the cut-bone coop died; and at the close of this experiment the fowls which had been receiving meat meal were nearer through moulting than the others.

Of course it is possible that the bone was not used in the best practicable manner; but it appears to be exceedingly difficult to secure an even distribution of this food. Some hens almost invariably secure more than their share, and this is equally true, whether the cut bone be scattered or mixed in a mash. The result is frequent diarrhœas. The meat meal, on the other hand, can be evenly mixed in a mash, so that all fowls share alike, as it cannot be picked out. Our results indicate that it is a safer feed than the bone; it is also a much cheaper feed; and, if it will give practically as many eggs, it is to be preferred. This experiment will be repeated.

REPORT OF ENTOMOLOGIST.

CHARLES H. FERNALD.

During the past year a great deal of time has been devoted to arranging and supervising experiments on the gypsy moth, and also to preparing, in conjunction with the field director, Mr. Forbush, a full report on this insect. The Commonwealth of Massachusetts has spent and is still spending large sums of money for its destruction, and in protecting the farmers of the State from the ravages of this notorious pest. It seemed wise and proper to devote much time and attention to the study of the gypsy moth and its habits, for the purpose of discovering the best and most economical methods for its destruction.

A large amount of time has been spent in preparing a complete account of our *Crambidæ*, which appears with six colored plates and structural details elsewhere in this report. This paper is designed to give all known scientific and practical knowledge that we possess about these insects, and it is hoped that the illustrations, in connection with the descriptions, will enable our farmers to determine any of these insects, and when they are found in large numbers in their grass lands, as often occurs, they may be better able to combat them.

Bulletin No. 28 was prepared by this division, and contains descriptions and illustrations of two species of canker worms, the army worm, the red-humped apple-tree caterpillar, the antiopa butterfly, the currant stem-girdler, the imported elm-bark louse and the greenhouse orthezia, together with methods of holding them in check.

On the 29th of March, my attention was called to some scale insects on several young plum trees on the grounds of the horticultural department of the Massachusetts Agricultural College, which proved to be the dreaded San José scale. These trees, according to the record books, came from the J. T. Lovett Company, Little Silver, N. J., in the spring of 1894.

Wishing to determine whether any of these insects had survived the winter, I had two of the trees taken up and set out in the cold part of the insectary greenhouse, and the remaining infested trees were burned. Scales appeared on the growth of the previous year, so that the insects succeeded well at least during the summer of 1894. On June 10, live scales were observed on the trees transplanted to the insectary greenhouse, and on the 14th the young were swarming all over them, and even extended to some small apple trees growing near in the same part of the greenhouse. As this seemed to settle the question of their ability to survive our winters here in Amherst, or at least the winter of 1894–95, which was an average one, I had all these trees very carefully burned, to prevent any further spreading of the pest. As soon as it was discovered that the San José scale had been received here on nursery stock from outside of the State, I feared that other nurseries might have become infested in a similar manner, and therefore I sent Mr. Lounsbury, who was my assistant at that time, to different nurseries to look for them. He reported that on April 19 he found the San José scale on two plum trees, two pear trees and a rose bush in Roslindale, Mass. The plum trees were badly infested with living scales, while the pear trees and rose bush were but slightly so. The scales occurred on all parts of the trees, but were the least numerous on the new growth. The pear trees had been on the grounds for three years and the plum trees two years. Mr. Lounsbury was informed that these trees were obtained from a local agent at West Roxbury, who claimed to have purchased them from the Shady Hill nursery, Bedford, Mass. On April 23 Mr. Lounsbury visited the Shady Hill nursery, and found the San José scale alive in large numbers on several different varieties of apple trees. Mr. Kohler, in charge of the nursery, told him that these trees were brought from the Cambridge nurseries, where they had been growing three or four years.

The Cambridge nursery was then visited, and pear, peach and apple trees were found infested with the scale, and many of the worst-infested trees were dead. As no stock had been added to this nursery for three years, these trees must have been infested at least that length of time. I have not been able to learn from what source the stock in this Cambridge nursery was obtained.

On July 9 I received a twig of an apple tree from Mr. W. W. Rawson, with the request to inform him what the matter was with it. An examination showed that it was infested with the San José scale. Further correspondence revealed the fact that the twig came from an apple tree in the orchard of Mr. E. E. Cole, in the town of Scituate. Mr. Cole wrote me that the orchard contained ninety trees that were set out three years ago. It is situated in a protected spot, with trees on three sides, and is within two miles of the ocean in a direct line. He also wrote me that the trees were received from Mr. Rawson, who informed me that he obtained most of his nursery stock of that description from the Shady Hill Nursery Company.

It is therefore probable that the Shady Hill nurseries received infested stock from some outside nursery, possibly in New Jersey, and have unintentionally become a centre of infection for orchards in the eastern part of this State. To what extent this pest has become distributed through the State it is impossible to say, but that it is able to live and destroy fruit trees in some if not in all parts of the State seems evident. A complete account of this insect was prepared and published with illustrations in the Massachusetts Crop Report for August.

The correspondence is steadily increasing, and many letters about injurious insects are received from nearly every part of the State. Most of these letters call for information about such insects as are causing more or less damage, and it is very rarely that we are called upon to give information about insects that have merely excited the curiosity of the sender.

The elm-leaf beetle appears to be rapidly spreading in the State, and we have been called upon frequently during the year for information about this beetle. A bulletin will soon be prepared on this and several other insects, which are so numerous as to cause much damage in various parts of the State, and about which we receive frequent inquiries.

Our studies on the cranberry insect are progressing as fast as other matters will permit, and it is our intention to prepare as complete a report on these insects as possible, at some future time.

REPORT OF HORTICULTURIST.

SAMUEL T. MAYNARD.

Owing to the recent separation of the horticultural and botanical divisions, the report from this division will partake more of an outline of the work to be undertaken than of results obtained.

The work has been carried on much in the same lines as in previous years. The season, up to the time of the severe hail storm, September 11, had been one that promised more than the average for the growth and perfection of nearly all of the crops under cultivation, and insects and fungous pests were not more than usually abundant. On September 11 one of the heaviest hail storms ever known in this section occurred, which resulted in almost the total destruction of the crops not matured at that time.

Protection of Crops from Insects and Fungous Diseases.

In growing the various fruit, vegetable and other crops, it is found necessary to protect them from insects and fungous pests, and much work has been done in using and testing insecticides and fungicides.

The lines of work pursued have been for the most part confined to testing large and small fruits, especially new varieties of promise; the various insecticides and fungicides recommended for their power to protect from common insect and fungous pests; all new varieties of vegetables and flowers sent in for trial by the originator or introducer, and some of the most promising obtained in the open market. Many new and promising ornamental trees and shrubs have been planted for comparison, and many new varieties of flowering and bedding plants have been added to the collection under glass. Comparisons have also been made respecting the effects of various kinds and different combinations of fertilizers upon growing crops.

EQUIPMENT.

This division requires for comparison a large number of standard varieties. These are already provided in the college orchard, vineyards, garden and greenhouses. In this work of comparison the most careful, painstaking observation is demanded. Suitable land is also required for the best growth of each crop, and a great variety of implements and tools for cultivating the same. Each different process requires its own tool, and facilities for storage must be provided, in order to market to the best advantage.

VARIETIES OF FRUITS.

The varieties of fruits now under observation on the college grounds may be enumerated as follows: —

Apples, 150 varieties; pears, 67; peaches, 49; plums, 103 (including types of all the groups according to the latest grouping); apricots, 13; nectarines, 2; quinces, 8, and many seedlings; cherries, 33; grapes, 143, and more than 500 seedlings not fruited; currants, 20; gooseberries, 17; red raspberries, 25, and many seedlings of the Shaffer type; black-cap raspberries, 31; blackberries, 21; strawberries, 157 named varieties, and about 600 seedlings from carefully crossed and selected varieties. Besides the above, there are growing many of the newer fruits, like the Japanese wineberry, May berry, salmon berry, Logan berry, strawberry-raspberry, Rocky Mountain cherry, sand cherry, June berry, Japanese walnut, Spanish, Japanese and hybrid chestnuts.

SPRAYING OUTFIT.

Machine Pumps. — The expense of applying insecticides and fungicides by hand pumps has been so great in the past that most of the work during the season just elapsed has been done with the Victor machine pump, resulting in a great saving of time, the power being applied by gearing attached to the wheels. This pump was worked very satisfactorily with all growths except large trees, where the time required to spray a single tree is so great that the power acquired by the motion of the wheels becomes exhausted before the tree is thoroughly sprayed in every part. This has necessitated driving around the tree several times, or working the pump by hand. Even with this pump, however, tall trees cannot be readily reached, and to obtain more reliable and more constant power a *steam pump* is being constructed, which is guaranteed to carry three streams through the ordinary three-quarter-inch hose at one time, fifty feet high. This will enable the hose to be taken into tall ornamental trees, and the work to be done more effectually, economically and quickly than by any of the ordinary hand or machine pumps. The pump, engine and tank, holding one hundred to one hundred and fifty gallons, will be compactly mounted on a low truck, with wheels having six-inch tires and bolster springs, that it may be drawn over soft or rough ground with the least jolting possible. The weight of engine, pump, tank and truck is expected not to exceed eight hundred pounds, and when the tank is filled to be easily drawn by two horses.

VEGETABLES.

During the past season the following number of varieties of vegetables has been tested: —

Asparagus, 3 varieties; artichoke, 2; beans, 11; beets, 6; Brussells sprouts, 2; carrots, 6; cabbages, 8; cauliflowers, 5; celery, 10; cucumbers, 6; sweet corn, 7; dandelion, 2; endive, 2; kohl-rabi, 2; lettuce, 5; onions, 6; parsley, 2; peppers, 4; egg-plant, 6; peas, 7; pumpkins, 4; radishes, 6; squashes, 11; spinach, 3; parsnips, 6; tomatoes, 16; rhubarb, 4.

SEED TESTING.

Seed testing is of the greatest practical importance to the farmer, market gardener and the florist, but at the same time it is most difficult so to conduct it as to obtain entirely satisfactory results. It will be hardly possible, with the present equipment, to make trial of the seeds of all of the varieties of farm and garden crops put upon the market by different growers, and it is planned to procure only those that are most largely grown and the new promising kinds. In the outline for this work it is proposed to make at least three tests of each variety under each of several methods adopted in the greenhouse, and three in the field at different dates, yet under as nearly the same conditions as possible. It is also proposed to test the quality of the products of each under ordinary field culture. In this way it is hoped to arrive at some definite conclusions respecting the comparative value of each variety for general cultivation, and the dependence of the crop on the quality of the seed.

Plants in the Greenhouses.

In these houses most of the promising new varieties of plants grown by the commercial florist are tested as they are introduced. The following is a partial list of the number of varieties tested: —

Carnations, 18 varieties; chrysanthemums, 30; coleus, 14; begonias, 31; bulbs, 55 species and varieties; geraniums, 24; roses, 12; violets, 3, etc.

REPORT OF METEOROLOGIST.

LEONARD METCALF.

Aside from the mere routine work incident to keeping up the daily meteorological records and observations, the work of the department has been confined chiefly to the compilation of data accumulated at this observatory during the past seven years. The records of this station, from the time of its foundation in 1889 to date, have been compiled and summarized, and tables have been prepared showing the maximum, minimum and mean observations. These results will probably be published in the form of a special bulletin early next year.

But few new instruments have been added to our equipment, — one or two new clocks for the self-recording instruments replace the old ones in case of emergency or mishap, and thus preserve the continuity of the records; and a new signal service standard Fahrenheit thermometer, for comparing and verifying the accuracy of the temperature indications of the wet and dry bulb thermometers, and the maximum, minimum and self-recording thermometers.

The ozone observations have been discontinued, owing to their uncertainty and unreliability. The amount of rainfall will henceforth be recorded on top of the tower, as on the ground, by means of a United States signal service standard rain gauge (as well as by the self-recording gauge), in order that the tower readings may be perfectly comparable with those of the ground.

REPORT OF CHEMIST.

DEPARTMENT OF FOODS AND FEEDING.

Conducted by J. B. LINDSEY, with the assistance of C. S. CROCKER, B.S., chemist; E. B. HOLLAND, B.S., chemist; G. A. BILLINGS, B.S., assistant in feeding department.

PART I.

LABORATORY WORK.

(*a*) Fodder analyses.
(*b*) Water analyses.
(*c*) Dairy products.

PART II.

FEEDING EXPERIMENTS AND DAIRY STUDIES.

(*a*) Chicago gluten meal *v.* King gluten meal.
(*b*) Chicago gluten meal *v.* Atlas meal.
(*c*) Composition of cream from different cows.
(*d*) Wheat meal *v.* rye meal for pigs.
(*e*) Salt hays and meadow hay (values for feeding).

PART I.

(*a*) FODDER ANALYSES.

We have received and analyzed for farmers during the year 49 samples of various grains, by-products and coarse feeds. We publish here only those having any particular interest, or that have more recently appeared in our markets. For analyses of all such feeds see complete table at the end of this report.

All cattle feeds have been divided into five groups of substances: —

1. *Crude ash* means the mineral ingredients contained in the plant or seed, such as lime, potash, soda, magnesia, iron, phosphoric acid, sulphuric acid and silicic acid. The ash serves to build up the bony structure of the animal.

2. *Crude cellulose* is the coarse or woody part of the plant; straws and hays contain large quantities, while in the grains and most by-products but little is present. It serves to produce vital energy and fat.

3. *Crude fat* includes the fats, waxes, resins, etc. It serves the same purpose as cellulose, but furnishes two and one-half times as much vital energy.

4. *Protein* is a general name for all nitrogen-containing bodies found in plants. It might be called "vegetable meat." It is a source of energy, possibly a source of fat, and *is the only source of flesh.*

5. Nitrogen-free extract consists of starch, sugars and gums. These substances produce energy and fat. Cellulose and extract are termed carbohydrates.

The grains are valuable chiefly for their extract matter, protein and fat. They contain very little cellulose. The estimation of protein and fat is as a rule all that is necessary to enable one to judge whether or not they are of superior, average or inferior quality.

Many by-products contain as small amounts of crude cellulose as do the grains. Others, such as brans, dried brewers' grains, etc., have from 7 to 12 per cent.

An estimation of the protein and fat only is necessary to enable one to get at their comparative values. Such feeds are bought chiefly for their protein content.

One-fourth to one-third of coarse fodders — hays, straws, corn fodders — consists of crude cellulose. This cellular matter, in so far as it is digestible, is equal in value to the digestible extract matter. Coarse fodders naturally constitute the bulk of the feed for neat stock, and are valuable chiefly for their cellular and extract matter (carbohydrates).

ANALYSES.

(*a*) *Gluten Feeds.* — The gluten feeds are being sold very largely in Massachusetts markets at the present time. They consist of the skin or hull, the germ and the gluten of the corn kernel. The Pope gluten feeds do not contain the germ.

CONSTITUENTS.	Peoria.	Peoria.	Peoria.	Buffalo.	Pope (White).	Pope (Yellow).
Water (per cent.), . .	9.00	9.00	9.00	9.00	9.00	9.00
Crude ash (per cent.), .	.91	-†	-†	.81	1.22	.99
" cellulose (per cent.),	7.69	-†	-†	7.10	6.04	6.35
" fat (per cent.), . .	11.72	13.07	11.04	11.92	7.39	7.21
" protein (per cent.), .	17.45	21.51	22.00	23.40	25.12	24.60
Extract matter (per cent.), .	53.23	-†	-†	47.77	51.23	51.85
	100.00	-	-	100.00	100.00	100.00

† Not determined.

These feeds are kiln dried, and contain from 7 to 10 per cent. of water. For the sake of comparison, they are all calculated to a uniform basis (9 per cent.). It will be noticed that the per cent. of protein varies from 17.5 to 25; *i. e.*, a 30 per cent. variation. The per cent. of fat also varies from 13.07 to 7.21; *i. e*, a 45 per cent. difference. These feeds, with such wide variations in protein and fat content, are sold practically at the same price per ton.

(*b*) *Oat Feeds.* — This material is being very largely offered. It consists of oat hulls, poor oats and the refuse from oat-meal factories, mixed with more or less ground barley, bran, inferior corn meal, etc. It is sold under a variety of names, such as oat feed, Quaker oat feed, corn and oat chop, etc.

CONSTITUENTS.	Oat Feed.	Corn and Oat Chop	Quaker Oat Feed.	Oat Feed.	Oat Feed.
Water (per cent.),	10.00	10.00	10.00	10.00	10.00
Crude ash (per cent.),	4.47	3.60	4.87	-†	3.73
" cellulose (per cent.),	15.13	11.62	14.68	14.88	11.76
" fat (per cent.),	3.64	4.11	3.68	3.73	4.23
" protein (per cent.),	10.70	10.69	12.33	11.32	10.18
Extract matter (per cent.),	56.06	59.98	54.44	-†	60.10
	100.00	100.00	100.00	-	100.00

† Not determined.

We cannot commend this article to farmers. It is made up of different materials, and in putting it upon the market the manufacturer simply is enabled to work off inferior articles and refuse. It of course has considerable feeding value, but the several ingredients can be bought cheaper in other materials, such as corn meal, gluten feed, etc.

(*c*) *Gluten Meal.* — This feed stuff is prepared from the hard, flinty portion (gluten) of the corn.

Since July the attention of the station has been frequently called to the difference in the appearance of the Chicago gluten meal. It formerly had a golden yellow color. A portion of that now appearing on the market has a light or grayish appearance. The manufacturers claim that this is due to the use of white corn.

CONSTITUENTS.	CHICAGO.						Pope Gluten Meal.
	OLD PROCESS.	IMPROVED PROCESS.					
	Yellow.	White	White.	White.	Yellow.	Yellow.	
Water (per cent.),	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Crude ash (per cent.),	.90	1.19	-†	-†	-†	-†	.58
" cellulose (per cent.),	1.10	3.39	-†	-†	-†	-†	1.72
" fat (per cent.),	6.20	6.02	7.20	6.51	6.59	6.93	7.55
" protein (per cent.),	30.50	38.39	38.77	37.41	38.96	42.21	36.60
Extract matter (per cent.),	52.30	42.01	-†	-†	-†	-†	44.55
	100.00	100.00	-	-	-	-	100.00

† Not determined.

The analyses of the so-called improved Chicago meal show it to contain a higher per cent. of protein than the old-process meal contained. The manufacturers claim that this is due to a more complete removal of the starch. Both the white or light and yellow meal have practically the same composition, and are consequently equally valuable for feeding.

(*d*) *Brans and Rice Meal.*

CONSTITUENTS.	Rex Bran.	Cotton-seed Meal Bran.	Cotton-seed Hull Bran.	Rice Meal.
Water (per cent.), ...	11.00	11.00	11.00	10.00
Crude ash (per cent.), . . .	3.35	2.87	1.93	8.40
" cellulose (per cent.), . .	18.74	28.60	34.99	5.63
" fat (per cent.), ...	2.71	3.89	1.09	13.17
" protein (per cent.), . . .	8.90	10.50	2.34	11.59
Extract matter (per cent.), . .	55.30	43.14	48.65	51.21
	100.00	100.00	100.00	100.00

The above brans are all much inferior to the average wheat bran. The rice meal is a good average sample of its kind, and possesses a feeding value similar to corn meal. Experiments are now in progress with this meal.

(b) WATER ANALYSIS.

To determine the healthfulness of a water for drinking, the object is to note the quantity, kind and condition of the organic matter, as well as the total amount of mineral constituents it contains.

All water contains more or less mineral matter in solution, derived from the soil through which it percolates. Moderate quantities (see limit below) are beneficial, and impart to the water a pleasant taste.

The method employed at this laboratory for testing waters is what is known as Wancklyn's process. This chemist interprets the results of his mode as follows: —

1. More than 71 parts per million of chlorine, accompanied by more than .08 part per million of free ammonia and more than .10 part per million of albuminoid ammonia, indicate that the water is polluted with sewage, decaying animal matter, urine, etc. (The amount of chlorine in water depends somewhat on the section of the State from which it comes.)

2. Total solids should not exceed 571 parts per million.

3. Water showing less than 5 degrees as here expressed is termed soft; between 5 and 10 degrees, medium; and above 10 degrees, hard.

"Albuminoid" ammonia is the ammonia derived from the breaking up of vegetable or animal matter in water, as a result of the action of certain chemicals in the process of analysis. Its presence indicates, therefore, that the water contains these matters in solution.

The presence of free or actual ammonia in water shows that these animal or vegetable substances are being decomposed by various bacterial growths. Much free ammonia is an indication that a water is suspicious or even dangerous for drinking.

Chlorine is one of the two components of common salt, and salt is always found both in the urine of human beings and in that of domestic animals, as well as in many waste waters. Excess of chlorine would therefore make it clear that a water contained sewage of some kind.

It is impossible, from a chemical analysis, to say whether or not a water is contaminated with the specific germ of any contagious disease. This is the work of the bacteriologist.

CHARACTER OF WATERS TESTED.

We have tested for farmers during the year 124 samples of water. Of these, 81, or 65.3 per cent., were found safe; 18, or 14.5 per cent., rather suspicious; and 25, or 20.2 per cent., dangerous for drinking. Five samples contained very noticeable quantities of lead derived from the lead pipe through which the waters flowed. Soft waters are especially liable to take up the lead. Every one is cautioned against the use of lead pipes, as waters containing this substance are very injurious to the health.

Sample Analyses of Different Waters.

QUALITY OF WATER.	PARTS PER MILLION.					CLARK'S DEGREES.
	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Total Solid Matter.	Mineral Solids.	Hardness.
Excellent,	–*	.04	5.00	70.0	46.0	–†
	.02	.07	3.00	70.0	32.0	1.43
	.01	.03	4.00	–†	–†	5.43
Good,	.01	.10	19.00	104.0	54.0	3.25
	.02	.12	7.00	–†	–†	1.11
	.04	.06	8.00	–†	–†	1.26
Suspicious,	.08	.07	18.00	–†	–†	–†
	.04	.11	38.00	336.0	186.0	10.15
	.04	.20	22.00	–†	–†	–†
Dangerous,	.16	.14	35.00	–†	–†	5.71
	.20	.08	22.00	–†	–†	–†
	.26	.48	2.00	84.0	22.0	2.47

* None. † Not determined.

It was not considered necessary to publish the analysis of each water analyzed during the year.

INSTRUCTIONS FOR SAMPLING AND SENDING WATER.

In dipping water from springs or drawing it from open wells, be sure that no foreign material falls into it. Do not take a sample from water that has stood in a pump for any length of time. Send at least two quarts, in *an absolutely clean* vessel. Waters received in dirty vessels are not tested, as the results would be of no value. A clean new stone or earthen jug is to be preferred.

Answer briefly the following questions in regard to the water: —

1. Is it well, shallow spring or hydrant water?
2. Do you suspect it to be the cause of any contagious disease?
3. Do you suspect lead poisoning?
4. What is the character of the ground through which it percolates?
5. How far is the well from house or barn?

(*c*) DAIRY PRODUCTS.

MILK, CREAM, ETC.

We have received and tested for farmers during the year 87 samples of milk, 18 samples of cream and 4 samples of butter; 24 samples of butter have also been analyzed for the Dairy Bureau. It is not considered necessary to publish these analyses here. They will be found tabulated at the end of the report.

INFORMATION.

Average cow's milk has approximately the following percentage composition: —

	Per Cent.		Per Cent.
Water,	87.0	Albumen,	.50
Fat,	3.7	Milk sugar,	5.10
Casein (curd),	3.0	Ash,	.70

For practical purposes, we generally estimate the percentage of total solids (which includes everything except water) and fat.

For convenience, the Massachusetts milk standard for 1895, as well as the average composition of cream, skim and butter milks, follow: —

CONSTITUENTS.	Massachusetts Standard.	SKIM-MILK.		CREAM.		Butter-milk.
		Deep Setting.	Separator.	Deep Setting.	Separator.	
Total solids (per cent.),	13.00*	9.50	–	26.5	–	8.33
Milk fat (per cent.),	3.70	.32	.10	18.0	25.-35.	.27
Solids not fat (per cent.),	9.30	–	–	–	–	–

* During May and June, 12 per cent.

INSTRUCTIONS FOR SENDING MILK.

Milk or cream should be sent by morning express, if possible. It should be marked "Immediate Delivery," and should not be sent later than Thursday of each week. Send one pint of milk and one-half pint of cream, preferably in Lightning or Mason fruit jars. *Be sure the vessels are perfectly clean.* Mix the milk or cream thoroughly before taking the sample, by pouring from one vessel to another.

PART II.

(*a*) CHICAGO GLUTEN MEAL *v.* KING GLUTEN MEAL.

EXPERIMENT WITH COWS.

Object of the Experiment.

The object of the experiment was to compare the relative merits of the two gluten meals for milk production.

Chicago Meal. — The general character and appearance of this meal is well known.

King Meal. — This meal is very probably a by-product from corn, the process of manufacture being somewhat different from that employed in case of the Chicago meal. It contains apparently no husks or germs; the fat from the germ, however, is present, making the meal very rich in this latter substance. For the sake of comparison the composition of the two meals is given below: —

CONSTITUENTS.	Chicago.	King.
Water (per cent.), ...	9.33	7.34
Crude ash (per cent.), ...	.13	1.38
" cellulose (per cent.), ...	1.57	1.30
" fat (per cent.), ...	4.17	18.48
" protein (per cent.), ...	33.64	35.57
Extract matter (per cent.), ...	51.17	35.93

Plan of the Experiment.

Four grade cows were employed, in different stages of lactation. The preliminary feeding period lasted seven days, and the feeding period proper seven days. All other feeds excepting the two gluten meals remained constant during the experiment. The data will be found in Table I. The following method was employed to overcome the natural milk shrinkage. The cows were divided into two lots. During the first period cows I. and III. received the King meal, at the same time cows IV. and VI. were receiving the Chicago meal; during the second period this order was reversed. This experiment was in operation during June, 1894. The cows were allowed the run of the barn-yard during the day, and so far as possible all conditions were identical during the entire time.

Table I.

PERIODS.	Number of Animals.	Length of Feeding Period (Days).	Average Live Weight (Pounds).	Average Daily Rations.								
				TOTAL.				DIGESTIBLE.				
				Wheat Bran (Pounds).	King Gluten Meal (Pounds).	Chicago Gluten Meal (Pounds).	Rowen (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	Total (Pounds).	Nutritive Ratio.
King, .	4	10	935	4.5	4.5	–	18	3.30	9.65	1.15	14.1	1:3.8
Chicago, .	4	10	937	4.5	–	4.5	18	3.16	10.49	.56	14.2	1:3.7

Table II. — *Average Yield and Cost of Milk.*

PERIODS.	Total Cost of Feeds (Dollars).	Total Yield of Milk (Quarts).	Average Daily Yield per Cow (Quarts).	Cost of Milk per Quart (Cents).
King, ...	$6 61	318.4	11.36	2.08
Chicago, ...	6 61	314.4	11.23	2.10

Comments on the Results.

Table I. shows that the cows consumed the same amount of digestible matter daily in each period.

Table II. shows that the daily yield of milk and the cost per quart were practically identical in each period.

The Chicago meal was in its usual good condition. In spite of the fact that the King meal contained nearly 20 per cent. of fat, no rancid odor or taste was noticed after the meal had been in the barn six months. Its mechanical condition was all that could be desired. The objection to feeding by-products especially rich in fat is that, if they are fed alone in large quantities (above 3 quarts daily) or fed in combination with other material of a similar nature, the tendency is to cloy the appetite of the animal, or — in warm weather especially — to produce inflammation of the milk glands.

In a daily grain ration of 9 pounds we would not advise feeding over 3 or 4 pounds of but one by-product having above 7 to 8 per cent. of fat.

The principal criticism on this experiment would naturally be the shortness of its feeding periods. This could not have been well avoided. The results obtained, however, are, it is believed, sufficient to give one an idea of the comparative value of the two grains.

(b) CHICAGO GLUTEN MEAL v. ATLAS MEAL.

Experiment with Cows.

Object of the Experiment.

The experiment was undertaken for the purpose of noting the feeding value of the new by-product Atlas meal, as compared with Chicago gluten meal.

Atlas Meal. — This is a comparatively new article in Massachusetts markets. It consists of the hull, gluten and germ of different grains left behind in the process of alcohol manufacture. It comes into the market ground fairly fine, and contains about the same amount of protein as does the Chicago meal. The amount of cellulose and fat is, however, in excess of the latter. The composition of the two grains follows: —

CONSTITUENTS.	Chicago.	Atlas.
Water (per cent.),	9.00	10.00
Crude ash (per cent.),	.13	.37
" cellulose (per cent.),	1.57	10.75
" fat (per cent.),	4.18	13.75
" protein (per cent.),	33.75	33.57
Extract matter (per cent.),	51.37	31.56

Plan of the Experiment.

The experiment was in operation during January and a part of February, 1895. The cows, four in number, were grades. The feeds consisted of hay, corn and soja-bean ensilage, bran, Chicago gluten meal and Atlas meal. The ensilage, hay and bran remained constant during the entire experiment. The preliminary feeding periods lasted seven days, the two periods proper ten days each. To overcome the natural milk shrinkage the following arrangement was instituted. The cows were divided into two lots. In Period I., cows 3 and 6 were fed Chicago meal at the same time that cows 4 and 5 were receiving Atlas meal. In Period II. this order was reversed. The cows were kept in the barn during the entire experiment, and were treated precisely alike during both periods. Two composite samples (three days each) of milk were tested during each period. The tables following give the average results from the four cows: —

TABLE I.

PERIODS.	Number of Animals.	Length of Feeding Periods (Days).	Average Live Weight (Pounds).	AVERAGE DAILY RATIONS.									
				TOTAL.					DIGESTIBLE.				
				Wheat Bran (Pounds).	Chicago Meal (Pounds).	Atlas Meal (Pounds).	Corn and Soja-bean Ensilage (Pounds).	Hay (Pounds).	Protein (Pounds).	Carbohydrates (Pounds).	Fat (Pounds).	Total (Pounds).	Nutritive Ratio.
Atlas, . .	4	10	943	4	-	4	42.1	5	2.46	9.15	1.17	12.78	1:4.9
Chicago, .	4	10	944	4	4	-	40.6	5	2.62	9.38	.84	12.84	1:4.4

TABLE II. — *Average Yield and Cost of Milk and Butter Fat.*

PERIODS.	Total Cost of Feed (Dollars).	Total Yield of Milk (Quarts).	Average Daily Yield per Cow (Quarts).	Cost per Quart (Cents).	Total Amount of Butter Fat (Pounds).	Total Cost of Butter Fat per Pound (Cents).
Atlas, . . .	$7 40	420.7	10.52	1.76	40.57	18.24
Chicago, . .	7 56	423.3	10.58	1.79	40.17	18.82

TABLE III. — *Average Composition of Milk.*

NUMBER OF COW.	PER CENT. SOLIDS.		PER CENT. FAT.	
	Atlas.	Chicago.	Atlas.	Chicago.
3, ...	14.13	14.33	4.22	4.72
4, ...	13.86	13.65	4.88	4.60
5, ...	13.38	13.16	4.17	4.12
6, ...	14.33	13.71	4.52	4.06
Average, ...	13.93	13.71	4.45	4.38

Results.

The cost and quantity of milk and butter fat are so nearly equal in each case as to be considered practically identical. If the quality of the Atlas meal is maintained, it can be regarded as an excellent food for milch cows and neat stock in general.

(c) WHAT CONSTITUTES A "SPACE" OF CREAM.

J. B. LINDSEY AND GEO. A. BILLINGS.

In the report of the State Experiment Station for 1894 it was shown that the butter fat in the cream gathered from 165 different farmers varied from 11 to 22 per cent. Such figures only serve to emphasize the unreliability of the "space" as a basis for payment.

During the past autumn we have tested the cream raised by the deep-setting process from each of the six cows belonging to the station. The conditions were precisely alike in each case, the milk being immersed for the same length of time, and the temperature of the water maintained at 38 to 40 degrees. The cows were all fresh in milk, having calved from one to two months previously.

History of the Cows.

Cow I., grade Ayrshire, six years old, weighing 800 pounds, yielding about 4 per cent. fat in milk.

Cow II., native, nine years old, weighing 900 pounds, yielding 4 per cent. fat in milk.

Cow III., grade Ayrshire-Jersey, seven years old, weighing 850 pounds, yielding 4.2 per cent. fat in milk.

Cow IV., grade Jersey, six years old, weighing 1,050 pounds, yielding 5 per cent. fat in milk.

Cow V., grade Durham, seven years old, weighing 1,050 pounds, yielding 3 per cent. fat in milk.

Cow VI., grade Durham-Jersey, about seven years old, weighing 1,000 pounds, yielding 5 per cent. fat in milk.

Table I. shows the daily results and the average for the three days (two days in case of cows V. and VI.).

TABLE I.

NUMBER OF COW.	Number of Days.	Milk per Day (Pounds).	Spaces Cream per Day.	Per Cent. of Fat in Cream.	Per Cent. of Fat in Skim-milk.
I., . . .	1, ...	25.90	8.10	16.90	.20
	1, ...	26.00	7.50	16.60	.15
	1, ...	25.50	7.80	16.10	.17
	Average, .	25.80	7.80	16.53	.17
II., . . .	1, ...	21.50	5.30	16.15	.55
	1, ...	22.00	5.50	15.90	.57
	1, ...	22.75	5.90	17.30	.55
	Average, .	22.08	5.57	16.45	.56
III., . . .	1, ...	25.50	11.50	11.20	.25
	1, ...	26.87	10.80	12.05	.30
	1, ...	26.50	11.60	12.70	.25
	Average, .	26.30	11.30	11.98	.27
IV., . . .	1, ...	25.95	8.10	21.00	.18
	1, ...	27.12	8.40	21.45	.20
	1, ...	25.00	8.10	22.65	.13
	Average, .	26.02	8.20	21.70	.17
V., . . .	1, ...	28.00	7.00	15.70	.17
	1, ...	30.63	7.10	16.20	.15
	Average, .	29.31	7.05	15.95	.16
VI., . . .	1, ...	31.12	10.90	20.25	.15
	1, ...	31.50	8.80	19.45	.13
	Average, .	31.31	9.85	19.85	.13

TABLE II. — *Showing the Results on the Basis of 25 Pounds of Milk per Cow.*

NUMBER OF COW.	Spaces of Cream.	Per Cent. of Fat in Cream.	NUMBER OF COW.	Spaces of Cream.	Per Cent. of Fat in Cream.
I., ...	7.56	16.53	IV., . . .	7.89	21.70
II., ...	6.30	16.45	V., . . .	6.01	15.95
III., ...	10.74	11.98	VI., . . .	7.87	19.85

Cows I., II. and V. produced the smallest number of spaces of cream, containing 16 to 16½ per cent. of fat. Cow III. produced nearly 11 spaces of cream with 12 per cent. of fat. Cows IV. and VI. produced nearly 8 spaces of cream each, containing from 20 to nearly 22 per cent. of fat.

According to the present system, cream is paid for at the same price per space, whether it contains 12, 16 or 22 per cent. of butter fat, *i. e.*, whether equal quantities of such cream will produce 12, 16 or 22 pounds of butter. Under this system a farmer with a herd of extra butter-producing cows, yielding cream by the deep-setting process, containing 19 to 22 per cent. of fat, receives no more money than another farmer who produces a like quantity of cream testing but 15 or 16 per cent. of fat. *The injustice must be apparent* to every thinking farmer. The investigation, as shown in the above tables, might have been carried still further by weighing the cream, calculating the *amount* of butter fat produced, and seeing how much butter a given number of spaces of each cow's cream would produce. This was done, however, in last year's investigation, and, at the risk of repetition, the summary of the results bearing on this point is presented in Table III. Our object in the present experiment has been simply to show how the per cent. of fat in the cream of six individual cows varied under exactly similar conditions.

TABLE III. — *Summary of Results obtained in 1894 with Cream gathered from 165 Farmers, showing Butter Equivalent from 100 Spaces of Graded Cream, and Value of Same.*

POUNDS OF BUTTER FAT FROM 100 SPACES OF CREAM.	Number of Patrons.	Per Cent. of Patrons.	Equivalent to Butter (Pounds).	Value of Butter at 25 Cents per Pound.
8-12, ...	10	6.1	13.42*	$3 35
12-13, ...	23	14.0	14.58	3 64
13-14, ...	52	31.5	15.75	3 94
14-15, ...	41	24.9	16.92	4 23
15-16, ...	30	18.2	18.08	4 52
16-18, ...	9	5.5	19.83	4 96

* Figured on the basis of 11.5 pounds of butter fat.

A full explanation of the Babcock system (by which the farmer is paid for the number of pounds of butter fat actually furnished by him), and how to put it into practical operation, has already been published.* This system offers encouragement for every one to improve his herd by weeding out the unprofitable cows and putting in their places only those that will produce good yields of rich milk.

Under the space system those farmers having extra cows that are well taken care of simply help out their shiftless neighbors who keep inferior animals. That the latter class of farmers is glad to be thus aided, and is as a rule opposed to any change, is not to be wondered at. How long the more thrifty, painstaking farmers will be willing to continue this, is a question for them to decide.

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* "Creamery Practice," by J. B. Lindsey, published by Dairy Bureau, 20 Devonshire Street, Boston, Mass.

(*d*) WHEAT MEAL *v.* RYE MEAL FOR PIGS.

OBJECT OF THE EXPERIMENT.

In this experiment it was intended to compare the feeding values of wheat and rye meal, when fed in combination with skim-milk to growing pigs.

PLAN OF THE EXPERIMENT.

The pigs were divided into two lots, two barrows and a sow being in each lot. The experiment was divided into three periods, covering in all 106 days. It was intended, in the first period, to feed 3 ounces of meal to each quart of milk, but the supply of milk being limited, some Peoria gluten feed was added to keep the ratio of protein to carbohydrates as 1 to 3.5.

In the second period 4 quarts of milk were fed daily, together with sufficient wheat or rye meal to satisfy appetites.

In the third period 4 quarts of milk were fed daily, in connection with equal parts of wheat or rye meal and corn meal to satisfy the appetites of the animals. Sufficient water was added to the milk and meal to furnish the necessary amount of liquid. The pigs were fed three times daily.

TABLE I. — *Feeding Plan.*

PERIOD.	Number of Days.	Feed.	Nutritive Ratio.
I., . .	58	3 ounces wheat or rye meal to each quart of milk, . .	1:3.6
II., . .	13	4 quarts milk daily, and wheat or rye meal to satisfy appetites.	1:4.0
III., . .	35	4 quarts milk, and equal parts wheat or rye meal and corn meal to satisfy appetites.	1:5.3

TABLE II. — *Average Daily Gain* (*Pounds*).

LOT.	Period I.	Period II.	Period III.	Total Average Daily Gain.
I., wheat, ...	1.06	1.21	1.49	1.22
II., rye, ...	1.00	1.15	1.20	1.10

TABLE III. — *Total Feed consumed.*

LOT I. (WHEAT).

PERIODS.	Skim-milk (Quarts).	Wheat Meal (Pounds).	Peoria Feed (Pounds).	Corn Meal (Pounds).	Nutritive Ratio.
I.,	744.0	205.1	73.5	-	1:3.6
II.,	195.0	114.0	-	-	1:4.0
III.,	450.0	212.5	-	212.5	1:5.2
Total,	1,389.0	531.6	73.5	212.5	-
Equal to dry matter,	283.7*	468.0	68.3	180.6	-

* Pounds.

LOT II. (RYE).

PERIODS.	Skim-milk (Quarts).	Rye Meal (Pounds).	Peoria Feed (Pounds).	Corn Meal (Pounds).	Nutritive Ratio.
I.,	744.0	205.10	73.5	-	1:3.8
II.,	195.0	114.00	-	-	1:4.4
III.,	450.0	183.75	-	183.75	1:5.4
Total,	1,389.0	502.80	73.5	183.75	-
Equal to dry matter,	283.7*	432.40	68.3	156.20	-

* Pounds.

TABLE IV.

	Lot I.	Lot II.
Average live weight at beginning of experiment (pounds),	33.33	34.20
Average live weight at end of experiment (pounds),	162.70	150.00
Average gain of each pig (pounds),	129.37	115.80
Average daily gain (pounds),	1.22	1.10
Dry matter required to produce 1 pound live weight (pounds),	2.58	2.71
Skim-milk actually returned per quart (fraction of cent),	.65	.55
Cost of feed for each pound of live weight gained (cents),*	4.25	4.58
Price received per pound of live weight (cents),	4.80	4.80

* On basis of following prices for feed: skim-milk, 2 cents per gallon; wheat and rye, $24 per ton; Peoria gluten feed, $21 per ton; and corn meal, $23 per ton.

Comments on Results.

Both lots of pigs made very fair gains, and the results as a whole compare favorably with other experiments, when skim-milk was fed with other grains. The average daily gain was nearly 1¼ pounds, and the dry matter required to make 1 pound of live weight averaged 2.65 pounds. The skim-milk returned .6 of one cent per quart, and the live weight cost 4.37 cents per pound, allowing skim-milk to be worth one-half cent per quart, and the grains as noted. The wheat meal seemed to give rather better results, especially in the last period. During this latter period the pigs fed on the rye-meal ration were off feed a good deal of the time, and gained less in weight. If the experiment had been continued longer, the results would have been still more in favor of the wheat meal.

Suggestions for Feeding Wheat or Rye Meal.

With pigs weighing from 30 to 100 pounds, feed 3 to 6 ounces meal to each quart of milk; with pigs weighing from 100 to 175 pounds, feed skim-milk at disposal (4 to 6 quarts per pig), and equal parts of wheat or rye meal and corn meal to satisfy appetites.

(*e*) SALT HAYS AND MEADOW OR SWALE HAY.

A. — Digestibility.
B. — How to feed them.

Summary of Results.

(*a*) Black grass, high-grown salt hay, branch grass and low meadow fox grass are all valuable fodder articles. In the present experiment black grass contained more protein and showed a higher average digestibility, and is therefore superior to the other three hays. There is no wide difference, however. Timothy hay shows more total digestible organic matter, but is noticeably inferior to three of the salt hays in digestible protein. Black grass might be classed as but little inferior to average timothy hay. High-grown salt hay, branch grass and fox grass resemble each other very closely in feeding value.

(*b*) Salt hays at average market prices are decidedly cheaper to feed than English hay.

(*c*) Meadow or swale hay is a very inferior article. It contained 150 to 200 pounds less digestible matter than did the salt hays, and but 39 per cent. of digestible dry matter.

(*d*) Hays containing much less than 50 per cent. of digestible dry matter should be regarded as of very inferior quality.

A. — Digestibility.

At the request of the experiment station, farmers in the vicinity of Newburyport sent four samples of salt hay. It was the intention of the writer to analyze these hays and test their comparative digestibilities. The hays were named as follows: —

1. Black grass (fine, and of dark color; consisted almost exclusively of *Juncus bulbosus*).
2. High-grown salt hay.
3. Branch grass.
4. Low meadow fox grass.

The low meadow fox grass appeared to consist practically of what is also called rush salt grass (*Spartina juncea*), and both the high-grown salt hay and the branch grass were composed of this as a basis, mixed with more or less coarse grass, probably *Spartina stricta*, variety *glabra*. The branch grass contained rather more of the coarse material than did the high-grown salt hay.

A sample of meadow or swale hay was also obtained, through the kindness of Mr. Chas. J. Peabody of Topsfield, in which vicinity large quantities are cut yearly. This hay grows in the fresh-water meadows, and is composed of fresh-water grasses, sedges, brakes and wild flowers.

The digestion tests were made with sheep, because these animals are much easier to work with, and give at the same time similar results as do cows and steers.

How the Digestible Matter of a Feed is determined.

First ascertain the amount and composition of the feed consumed by an animal in a given length of time, also the amount and composition of the fæces or undigested portion excreted in the same time on the basis of dry matter. The difference between them will represent the amount of the various constituents of the food digested.

The percentages of the constituents digested are called the digestion coefficients.

TABLE I. — *Composition of Hays.*

[The analysis of each hay is given on the basis of 15 per cent. of water, for the sake of comparison.]

FODDER CONSTITUENTS.	Black Grass.	High-grown Salt Hay.	Branch Grass.	Low Meadow Fox Grass.	Meadow Hay.	Timothy Hay for Comparison.
Water,	15.00	15.00	15.00	15.00	15.00	15.00
Crude ash,	9.91	6.92	8.75	4.96	5.27	4.30
" cellulose,	22.78	22.45	22.50	22.58	26.40	28.40
" fat,	2.23	2.13	1.88	2.18	1.59	2.40
" protein,	8.08	6.36	7.03	6.06	6.77	6.30
Nitrogen-free extract matter,	42.00	47.14	44.84	49.22	44.97	43.60
	100.00	100.00	100.00	100.00	100.00	100.00

TABLE II. — *Showing Average Digestion Coefficients obtained with Two Sheep.*

FODDER CONSTITUENTS.	Black Grass.	High-grown Salt Hay.	Branch Grass.	Fox Grass.	Meadow Hay.	Timothy Hay for Comparison.
Total dry substance, . .	59.5	53.0	56.0	53.0	39.0	58.0
Crude cellulose, . . .	60.5	50.0	52.0	51.0	33.0	53.0
" fat, ...	41.5	47.0	32.0	24.0	44.0	61.0
" protein, . . .	63.0	63.0	62.5	57.0	34.0	48.0
Nitrogen-free extract matter,	57.0	53.0	54.0	52.0	46.0	63.0

TABLE III. — *Showing Pounds of Digestible Organic Matter in 2,000 Pounds of the Several Hays, assuming Each Hay to contain an Average Amount of Water (15 Per Cent.).*

FODDER CONSTITUENTS.	Black Grass.	High-grown Salt Hay.	Branch Grass.	Fox Grass.	Meadow Hay.	Timothy Hay for Comparison.
Crude cellulose, . . .	275.6	224.4	234.0	230.2	174.24	301.00
" fat, ...	18.5	20.0	12.0	10.4	14.03	29.28
" protein, . . .	101.8	80.0	87.8	69.0	46.02	60.40
Extract matter, . . .	479.8	499.6	484.2	511.8	413.72	549.36
Total, ...	875.7	824.0	818.0	821.4	648.06	940.04

The teachings of the above tables will be found summarized at the beginning of the article. The writer has hesitated about making too sharp distinctions between the several kinds of salt hay, in view of the fact that he has worked with but one sample of each kind. It is well known that late-cut hays are inferior in per cent. of protein and less digestible than early-cut hays; and the writer has no means of knowing with certainty, either from the appearance of the samples or otherwise, whether or not they were cut at the same stage of growth. Very few blossoms were to be found indicative of an early cutting. It is also recognized that the condition and situation of the land exert an influence upon the quality of the hay. On the other hand, the hays were selected by men practically familiar with such material, and pronounced fair samples of their kind.

B. — How to feed Salt and Meadow Hays.

(*a*) *Salt Hays.*

Only general directions can be given. First, these hays, having a value approaching an average English hay, can be fed in place of the latter article in so far as composition and digestibility (*i. e.*, quality) are concerned. In the second place, however, the amount of salt they contain will exert a controlling influence on the quantity that the animal can consume. The per cent. of salt in the four samples received was as follows: —

	Black Grass.	High-grown Salt Hay.	Branch Grass.	Fox Grass.	Average English Hay.
Per cent. salt,	6.35	3.20	4.09	2.51	1.50

This per cent. would probably vary from time to time, depending on the frequency with which the salt water came in contact with the meadows, etc. Should black and branch grasses contain on an average as much salt as found in the present case, it would hardly seem wise to feed over one-third to one-half of these grasses in the entire coarse fodder ration, while in case of the high-grown salt hay and the fox grass two-thirds to even the entire coarse fodder ration could consist of these hays. The experience of practical feeders can and has undoubtedly solved this problem. The majority of farmers will probably prefer to feed about one-half salt hay and one-half English hay or other coarse material.

Coarse fodders can for practical purposes be fed *ad libitum; i. e.*, the animals can be given all they will consume. This can be left to the judgment of the practical feeder.

Grain Rations (on basis of milch cows of 1,000 pounds live weight). — The following rations are combined to go with the coarse fodders: —

I.		II.	
	Pounds.		Pounds.
Cotton-seed meal,*	100	Linseed meal,*	100
Wheat bran,	100	Pope or King gluten meal,*	100
Corn meal,†	100	Wheat bran,	200
Mix and feed 6 to 9 quarts daily.		Feed 7 to 9 quarts daily.	

III.		IV.	
	Pounds.		Pounds.
Chicago gluten meal,*	100	Gluten meal,	100
Wheat bran,	100	Corn meal,	100
Gluten feed,‡	100	Feed 6 quarts daily.	
Feed 6 to 9 quarts daily.			

V.	
	Pounds.
Cotton-seed meal,	100
Wheat bran,	100
Feed 8 quarts daily.	

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* Cotton-seed meal, linseed meals and the various gluten meals can be substituted one for the other. Cotton-seed meal, King and Pope gluten meal, on account of the high percentage of fat they contain, should not be fed together in the same ration.

† Chicago maize feed, Buffalo and Peoria or other gluten feeds can be used interchangeably.

‡ Gluten feeds can usually be substituted for corn meal with good effect.

(*b*) *Meadow Hays* (*for Milch Cows of 1,000 Pounds Live Weight*).

Meadow hay, being of inferior nutritive value, must be supplemented with feed stuffs containing large amounts of digestible matter, — especially protein, — in order to secure good results.

Coarse Fodder Ration 1. — Feed all the meadow hay the animal will eat.

Grain Rations for above.

I.		II.	
	Pounds.		Pounds.
Corn meal,	200	Corn meal,	100
Cotton-seed meal,	100	Wheat bran,	100
Feed 9 quarts daily.		Cotton-seed meal,	100
		Feed 10 quarts daily.	

III.

	Pounds.
Wheat bran,	100
Gluten feed,	100
Feed 14 to 16 quarts daily.	

Coarse Fodder Ration 2. — About one-half English hay and one-half meadow hay, or about one-half corn ensilage (30 pounds) and all the meadow hay the animal will eat.

Grain Rations for Above.

I.		II.	
	Pounds.		Pounds.
Corn meal,	150	Wheat bran,	100
Cotton-seed meal,	100	Gluten feed,	100
Feed 7 quarts daily.		Feed 10 to 12 quarts daily.	

Remarks. — The writer questions the wisdom of a system of farming in which much labor is devoted to securing meadow hay for feeding to farm animals. The large amount of grain necessary to be fed in order to secure reasonably nutritive rations calls for a considerable outlay of money, which renders the various rations of doubtful economy.

The tendency of modern dairy farming is to raise crops containing more nitrogenous matter (protein), and thus reduce the amount of grain to be purchased.

To farmers who have been gathering and feeding large quantities of meadow hay the writer would make the following suggestions: —

In addition to English hay, raise annual crops, such as peas and oats, vetch and oats and Hungarian grass. Cut these for hay. Grow corn fodder and soja-bean fodder, and put into a silo in the proportion of two parts corn to one part soja beans. Such a system will give large amounts of nutritious winter feed, and will enable one to get along with one-half of the grain feed mentioned above.

How to purchase Grains.

In making up grain rations cost must be considered, and one should be familiar with the fluctuating market values of the several feed stuffs in order to make economical combinations. The following figures show the approximate commercial values of the different feeds, based on the amount of digestible protein they contain : —

Wheat bran, ...	$18 00	$14 00
Corn meal, ...	19 00	15 00
Wheat middlings, ...	21 00	16 00
Brewers' grains, ...	21 00	16 00
Malt sprouts, ...	23 00	18 00
Gluten and maize feeds, ...	28 00	22 00
Atlas meal, ...	31 00	24 00
Old-process linseed meal, ...	31 00	24 00
New-process linseed meal, ...	32 50	25 00
Gluten meals, ...	35 00	27 00
Cotton-seed meal,.	35 00	27 00

The above figures do not express the relative physiological effect of the different grains, but show their comparative values in digestible protein after figuring the digestible carbohydrates and fat at a definite price. They can be used as guides in purchasing.

COMPILATION OF ANALYSES OF FODDER ARTICLES AND DAIRY PRODUCTS,

MADE AT

AMHERST, MASS.

1868-1896.

PREPARED BY C. S. CROCKER.

A. FODDER ARTICLES.
B. FERTILIZING INGREDIENTS IN FODDERS.
C. DAIRY PRODUCTS.

A. *Composition and Digestibility of Cattle Feeds.*

[Figures equal percentages or pounds in 100.]

NAME.	Analyses.	COMPOSITION.										DIGESTIBILITY.							
		FRESH OR AIR-DRY SUBSTANCE.						WATER-FREE SUBSTANCE.				FRESH OR AIR-DRY SUBSTANCE.				WATER-FREE SUBSTANCE.			
		Water.	Ash.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.
I. Green Fodders.																			
Fodder corn,	33	74.90	1.21	5.2	.5	2.0	11.7	25.2	2.4	9.8	56.7	2.7	.40	1.1	8.7	25.2	1.8	5.2	42.0
Fodder-corn ensilage,	38	78.30	1.20	6.0	.8	1.9	11.8	27.7	3.8	8.7	54.4	4.1	.60	.9	7.9	18.8	3.0	4.5	36.4
Corn and soja-bean ensilage,	3	76.50	2.60	7.3	.9	2.5	10.2	31.2	4.0	10.5	43.5	-	-	-	-	-	-	-	-
Oat and pea ensilage,	1	38.02	5.70	19.4	2.4	8.5	26.0	31.3	3.9	13.7	41.8	-	-	-	-	-	-	-	-
Millet and soja-bean ensilage,	6	75.70	3.00	7.3	1.0	3.0	10.0	30.2	4.0	12.3	41.4	-	-	-	-	-	-	-	-
Millet ensilage,	3	73.80	2.40	7.5	.8	1.7	13.8	33.3	3.1	6.6	52.3	-	-	-	-	-	-	-	-
Sorghum,	6	82.60	1.20	4.6	.3	1.5	9.8	26.7	1.5	8.7	56.3	2.7	.20	.7	7.2	15.8	1.1	4.0	41.7
Common millet,	9	64.60	1.70	11.0	1.0	2.6	19.1	31.0	2.7	7.5	54.0	-	-	-	-	-	-	-	-
Japanese millet (white head),	3	75.20	1.20	8.5	.6	2.2	12.3	34.5	2.3	8.7	49.6	-	-	-	-	-	-	-	-
Japanese millet (red head),	6	72.70	1.70	8.8	.5	1.9	14.4	32.1	2.0	6.9	52.9	-	-	-	-	-	-	-	-
Panicum miliaceum,	1	69.40	1.70	8.2	1.2	1.8	17.7	26.8	3.8	6.0	57.8	-	-	-	-	-	-	-	-
Panicum crus-galli,	2	72.90	2.10	7.6	.7	2.7	14.0	27.9	2.5	9.7	52.2	-	-	-	-	-	-	-	-
Mochl millet,	3	62.60	2.60	9.5	.7	3.7	20.9	25.6	1.8	9.9	55.7	-	-	-	-	-	-	-	-

Green oats,	6	74.00	2.10	7.8	.8	3.6	11.7	30.0	2.9	13.9	44.0	4.4	.50	2.5	8.5	17.0	1.7	9.7	32.8
Green barley,	1	79.10	1.80	7.9	.6	2.7	7.9	37.8	2.9	13.1	37.5	4.4	.40	1.8	5.8	21.1	1.7	9.2	27.4
Green rye,	2	72.00	1.60	8.9	.6	2.1	14.8	31.8	2.2	7.5	52.8	5.0	.40	1.5	10.8	19.1	1.3	4.2	38.5
Timothy (*Phleum pratense*),	2	65.40	1.70	11.3	.7	3.2	17.7	32.9	2.0	8.5	51.3	6.3	.40	1.5	11.7	18.4	1.1	4.1	33.9
Hungarian grass,	2	74.20	2.10	7.0	.5	2.6	13.6	27.9	1.7	9.4	53.0	4.8	.30	1.6	.9	19.0	.9	5.8	35.0
Vetch and oats (1 part vetch, 4 parts oats),	1	79.20	1.90	6.3	.8	2.8	9.0	30.3	3.9	13.3	43.7	4.2	.20	1.7	4.9	20.0	.7	8.0	23.6
Vetch and oats (1 part vetch, 9 parts oats),	3	81.00	1.70	6.4	.5	1.9	8.5	33.6	2.5	10.1	44.8	-	-	-	-	-	-	-	-
Vetch and oats (equal parts of each),	1	82.00	1.70	5.4	.5	3.0	7.4	29.8	2.8	16.8	41.3	-	-	-	-	-	-	-	-
Barley and peas,	1	83.90	1.30	5.4	.5	2.2	6.7	33.5	3.0	13.4	41.8	3.2	.24	1.7	4.1	20.1	1.3	10.3	25.5
Oats and peas,	2	84.00	1.30	4.7	.5	2.4	7.1	29.4	2.8	15.1	44.4	2.8	.24	1.8	4.3	17.6	1.2	11.6	27.1
Horse bean,	1	84.80	.90	4.3	.4	2.5	7.1	28.2	2.3	16.7	47.0	-	-	-	-	-	-	-	-
Flat pea,	2	78.80	1.90	5.2	.9	6.1	7.1	24.3	4.1	29.0	33.5	-	-	-	-	-	-	-	-
Soja bean,	14	75.50	2.50	6.5	1.1	4.2	10.2	26.5	4.6	17.3	41.6	3.4	.30	2.9	6.7	14.0	1.4	11.9	27.5
Soja bean (early white),	4	69.80	3.90	6.7	.8	5.0	13.8	22.8	2.7	16.5	45.2	-	-	-	-	-	-	-	-
Soja bean (early green),	1	69.90	3.90	7.1	1.2	5.8	12.1	23.5	3.9	19.4	40.2	-	-	-	-	-	-	-	-
Soja bean (early black),	1	82.20	2.30	4.5	.6	2.9	7.5	25.1	3.4	16.2	42.4	-	-	-	-	-	-	-	-
Soja bean (medium black),	1	76.90	2.90	5.0	1.6	5.0	8.6	21.7	6.8	21.7	37.1	-	-	-	-	-	-	-	-
Soja bean (late),	4	74.00	3.50	5.5	.7	5.9	10.4	21.1	2.8	22.8	39.7	-	-	-	-	-	-	-	-
Bokhara clover,	3	78.80	2.10	6.3	.6	4.2	8.0	29.5	3.0	19.7	37.9	-	-	-	-	-	-	-	-
Kidney vetch,	1	80.80	2.60	2.9	.7	3.5	9.5	14.9	3.5	18.4	49.9	-	-	-	-	-	-	-	-
Serradella,	3	82.40	1.90	5.3	.4	2.6	7.4	30.1	2.4	15.0	41.5	2.7	.30	2.0	19.0	15.1	1.6	11.3	26.1
Prickly comfrey,	1	86.80	2.80	1.5	.3	2.3	6.3	11.0	2.1	17.5	48.3	-	-	-	-	-	-	-	-

A. Composition and Digestibility of Cattle Feeds — Continued.

NAME.	Analyses.	COMPOSITION.										DIGESTIBILITY.							
		FRESH OR AIR-DRY SUBSTANCE.						WATER-FREE SUBSTANCE.				FRESH OR AIR-DRY SUBSTANCE.				WATER-FREE SUBSTANCE.			
		Water.	Ash.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.
I. Green Fodders — Concluded.																			
Spurry,	1	72.30	2.60	7.0	.1	2.9	14.1	25.4	3.9	10.3	51.1	-	-	-	-	-	-	-	-
White lupine,	1	85.30	.70	4.6	.4	2.7	6.3	31.2	2.4	18.7	42.7	-	-	-	-	-	-	-	-
Yellow lupine,	1	86.00	1.50	3.8	.3	2.5	5.9	27.1	1.9	17.8	42.1	-	-	-	-	-	-	-	-
Spanish moss,	1	60.80	1.10	12.7	1.0	1.8	22.6	32.6	2.5	4.5	57.7	-	-	-	-	-	-	-	-
II. Hay and Dry Coarse Fodders.																			
English hay (mixed grasses),	60	14.00	5.40	26.7	2.4	8.1	43.1	31.1	2.8	9.5	50.3	16.0	1.1	4.8	25.4	18.7	1.4	5.6	29.7
Canada hay,	4	14.00	4.60	28.1	2.1	6.1	44.9	32.7	2.5	7.1	52.2	14.6	1.2	2.9	32.9	19.0	1.7	3.9	32.9
Rowen of mixed hays,	15	17.00	5.90	22.2	3.0	10.5	41.2	26.8	3.6	12.7	49.7	14.2	1.1	7.1	27.2	17.2	1.2	7.9	32.8
Timothy hay,	6	14.00	4.20	28.3	1.9	8.5	44.1	32.9	2.2	8.7	51.3	14.7	1.1	4.1	27.8	19.1	1.3	4.9	32.3
Red-top hay (*Agrostis vulgaris* With.),	4	14.00	4.30	28.3	1.4	6.8	45.2	32.9	1.6	7.9	52.6	17.3	.7	4.1	28.0	20.1	.8	4.8	32.6
Kentucky blue-grass (*Poa pratensis* L.),	2	14.00	7.20	29.7	1.8	7.5	39.7	34.6	2.1	8.7	46.2	-	-	-	-	-	-	-	-
Orchard grass (*Dactylis glomerata* L.),	4	14.00	6.10	30.0	2.5	8.1	39.3	34.9	2.9	9.4	45.7	18.3	1.4	4.9	21.6	21.3	1.6	5.6	25.1
Meadow fescue (*Festuca pratensis* Huds.),	5	14.00	7.90	31.7	1.6	5.8	39.8	36.9	1.9	6.8	46.3	-	-	-	-	-	-	-	-

Perennial rye-grass (*Lolium perenne* L.),	4	14.00	7.90	25.4	2.1	10.1	41.4	29.6	2.4	11.7	48.2	-	-	-	-	-	-	-	-
Italian rye-grass (*Lolium Italicum* A. Br.),	4	14.00	6.50	28.6	1.6	7.1	42.2	33.3	1.9	8.2	49.1	-	-	-	-	-	-	-	-
Hungarian grass,	1	14.00	4.90	27.5	1.9	8.2	43.5	32.0	2.2	9.5	50.6	18.7	1.2	4.9	29.1	21.8	1.4	5.7	33.9
Barn-yard grass,	1	14.00	8.60	29.0	1.7	13.1	32.9	33.7	2.0	15.3	38.2	18.2	1.0	8.1	21.7	21.2	1.2	9.5	25.2
Hay of black grass (salt),	2	16.00	7.70	24.4	2.4	6.8	41.6	29.1	2.9	8.1	49.5	14.6	1.0	4.3	23.3	17.5	1.2	5.1	27.7
High-grown salt hay,	1	16.00	7.00	22.2	2.1	6.3	46.6	26.4	2.5	7.5	55.5	11.0	1.0	4.0	24.7	13.2	1.2	4.7	29.4
Branch grass (salt),	1	16.00	8.80	22.3	1.8	7.0	44.4	26.5	2.2	8.3	52.8	11.5	.6	4.3	24.0	13.8	.7	5.1	28.5
Low meadow fox grass (salt),	1	16.00	5.40	22.3	2.2	6.0	48.6	26.6	2.6	7.1	57.9	11.4	.5	3.4	25.3	13.7	.6	4.0	30.1
Salt hay (variety unknown),	2	16.00	4.30	24.0	2.5	3.4	50.5	27.8	3.0	4.1	60.1	-	-	-	-	-	-	-	-
Vetch and oats (1 part vetch, 4 parts oats),	1	14.00	7.60	26.1	3.3	11.4	37.6	30.3	3.9	13.3	43.7	17.2	.6	6.8	20.3	20.0	.7	8.0	23.6
Vetch and barley,	2	14.00	5.30	27.9	2.0	11.9	38.9	32.4	2.3	13.9	45.2	18.4	.4	7.1	21.0	21.4	.5	8.3	24.4
Low meadow or swamp hay,	2	14.00	5.80	26.7	1.9	7.1	44.8	31.1	2.2	8.3	52.1	8.8	.8	2.4	20.6	10.2	1.0	2.8	23.9
Millet,	6	16.00	4.30	28.0	1.8	6.5	43.4	33.3	2.1	7.8	51.7	-	-	-	-	-	-	-	-
Oats in bloom,	1	15.00	5.60	30.6	2.4	5.5	42.0	34.1	2.9	6.6	50.0	17.1	1.5	3.9	30.7	19.0	1.8	4.6	36.5
Oats in milk,	1	15.00	5.20	29.2	2.3	9.3	39.1	34.3	2.7	10.9	46.0	16.3	1.4	6.5	28.5	19.2	1.7	7.6	32.6
Oats, ripe,	1	15.00	5.30	30.9	2.2	5.2	41.6	36.3	2.6	6.1	48.9	-	-	-	-	-	-	-	-
Winter rye in bloom,	1	15.00	5.40	28.1	2.2	9.1	40.2	33.0	2.6	10.7	47.3	15.7	1.4	6.4	29.4	18.4	1.6	7.5	34.5
Barley in milk,	1	15.00	4.20	24.7	2.4	8.8	44.9	29.1	2.8	10.3	52.8	13.8	1.5	6.2	32.8	16.3	1.7	7.2	38.5
Dry corn fodder,	4	20.00	4.10	23.4	1.4	6.2	45.9	29.3	1.8	7.7	56.1	15.2	1.0	3.7	34.0	16.1	1.4	4.1	42.6
Corn stover,	30	20.00	4.70	28.3	1.1	5.9	40.4	34.9	1.4	7.4	50.5	18.9	.6	3.1	25.9	23.4	.7	3.8	32.3
Common buckwheat,	1	8.50	13.40	17.8	2.7	16.4	41.2	19.4	3.0	17.9	45.1	-	-	-	-	-	-	-	-
Silver-hull buckwheat,	1	8.90	9.30	24.7	2.4	11.1	43.6	27.1	2.6	12.2	47.9	-	-	-	-	-	-	-	-

A. Composition and Digestibility of Cattle Feeds — Continued.

NAME.	Analyses.	COMPOSITION.										DIGESTIBILITY.							
		FRESH OR AIR-DRY SUBSTANCE.						WATER-FREE SUBSTANCE.				FRESH OR AIR-DRY SUBSTANCE.				WATER-FREE SUBSTANCE.			
		Water.	Ash.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.
II. Hay and Dry Coarse Fodders — Con.																			
Japanese buckwheat,	1	5.70	11.70	33.9	2.1	10.2	36.4	36.0	2.2	10.8	38.6	-	-	-	-	-	-	-	-
Teosinte,	1	6.10	6.60	27.1	1.2	9.1	49.9	28.9	1.3	9.7	53.1	-	-	-	-	-	-	-	-
Mammoth red clover,	3	11.40	8.70	24.4	1.9	14.0	39.6	27.5	2.1	15.8	44.8	-	-	-	-	-	-	-	-
Alsike clover,	6	10.00	10.70	23.6	2.3	14.9	38.5	26.2	2.6	16.6	42.7	12.5	1.2	9.2	27.2	13.9	1.3	9.8	30.3
Medium red clover,	2	5.60	8.50	28.7	2.4	14.0	40.8	30.4	2.5	14.8	43.3	15.2	1.2	9.2	30.0	16.1	1.3	9.8	30.7
Ground clover (poultry feed),	1	14.80	7.40	28.3	2.0	12.6	34.9	33.2	2.3	14.8	41.0	-	-	-	-	-	-	-	-
Lucerne (alfalfa),	6	9.70	7.20	27.7	1.7	12.3	41.4	30.7	1.9	13.6	45.8	13.6	1.0	9.5	22.3	15.0	1.2	10.5	26.4
Sand lucerne,	1	8.80	8.80	19.4	2.4	14.9	45.7	21.3	2.6	16.3	50.2	-	-	-	-	-	-	-	-
Bokhara clover,	5	8.00	8.30	27.5	2.9	15.8	37.5	29.9	3.2	17.2	40.7	-	-	-	-	-	-	-	-
Blue melilot,	1	8.20	13.70	25.0	1.6	12.7	39.8	27.2	1.7	13.8	42.4	-	-	-	-	-	-	-	-
Sainfoin,	3	9.90	7.80	21.6	3.1	15.7	41.9	24.0	3.4	17.4	46.5	-	-	-	-	-	-	-	-
Sulla,	2	9.40	8.40	18.8	2.5	15.4	45.5	20.7	2.8	17.0	50.2	-	-	-	-	-	-	-	-
Hairy lotus,	2	11.50	7.30	17.5	2.6	13.1	48.0	19.8	2.9	14.8	54.2	-	-	-	-	-	-	-	-
Summer rape,	1	11.10	16.30	16.2	3.4	12.8	40.2	18.2	3.8	14.4	45.3	-	-	-	-	-	-	-	-

Winter rape,	1	10.10	20.00	11.1	2.8	13.7	42.3	12.3	3.1	15.2	47.0	-	-	-	-	-	-	-	-
Dwarf Essex rape,	1	7.70	14.90	17.5	3.5	11.9	44.5	19.0	3.8	12.9	48.2	-	-	-	-	-	-	-	-
Soja bean,	4	12.10	7.30	21.1	4.1	14.2	41.2	24.0	4.7	16.2	46.8	11.2	1.2	9.8	27.2	12.7	1.4	11.2	30.9
Cow pea,	3	9.60	8.40	19.6	3.7	15.5	43.2	21.7	4.1	17.1	47.8	8.4	1.9	10.1	28.6	9.3	2.1	11.1	30.3
Small pea,	1	5.80	5.90	31.0	1.4	15.6	40.3	32.9	1.5	16.6	42.7	-	-	-	-	-	-	-	-
Flat pea,	1	8.90	8.60	29.0	1.7	21.9	29.9	31.8	1.9	24.0	32.9	-	-	-	-	-	-	-	-
Serradella,	3	9.60	6.40	22.8	2.4	15.4	43.4	25.2	2.6	17.0	48.1	11.4	1.8	10.0	27.3	12.6	2.0	11.1	30.3
Hairy vetch,	1	7.40	7.80	29.5	1.1	18.2	36.0	31.9	1.2	19.6	38.9	-	-	-	-	-	-	-	-
Common vetch,	2	8.90	7.50	27.7	2.3	13.8	39.8	30.4	2.5	15.1	43.8	15.0	1.4	10.5	26.3	16.4	1.5	11.5	28.9
Scotch tares,	1	5.80	11.60	26.1	1.6	18.4	26.5	30.9	1.9	22.0	31.4	-	-	-	-	-	-	-	-
Vetch and oats (equal parts each),	2	9.40	8.20	27.7	2.6	15.4	36.7	30.6	2.9	17.0	40.4	-	-	-	-	-	-	-	-
Vetch and oats (proportion unknown),	3	11.70	6.80	28.9	2.7	8.5	41.4	32.7	3.1	9.6	46.9	19.1	.5	5.1	22.4	21.6	.6	5.8	25.3
Vetch, oats and horse bean,	1	10.20	9.30	27.0	2.4	17.0	34.1	30.1	2.7	18.9	37.9	-	-	-	-	-	-	-	-
Horse-bean straw,	1	9.10	8.70	37.6	1.4	8.9	34.3	41.4	1.5	9.7	37.8	14.7	.7	4.4	22.0	16.1	.8	4.8	24.2
Soja-bean straw,	3	11.40	6.40	37.6	1.9	4.9	37.8	42.4	2.2	5.5	42.7	14.3	1.1	2.5	24.9	16.1	1.3	2.8	28.2
White daisy (*Chrysanthemum*, etc.),	1	9.60	6.40	32.6	2.1	7.0	42.3	36.1	2.3	7.7	46.8	15.0	1.3	4.1	28.3	16.6	1.4	4.5	31.3
Dry carrot tops,	1	9.80	12.50	12.3	1.8	19.1	45.5	13.6	2.0	20.1	50.4	-	-	-	-	-	-	-	-
Wheat straw,	1	6.20	4.50	33.7	1.5	6.8	47.3	35.9	1.6	7.2	50.5	18.9	.5	1.2	20.3	20.1	.6	1.2	20.3
Barley straw,	2	10.00	5.10	34.1	2.6	6.9	42.3	36.8	2.9	7.7	47.0	19.1	1.1	1.4	22.8	20.6	1.2	1.5	25.4
Japanese millet (white head),	1	8.50	4.70	32.0	2.2	7.0	45.6	35.0	2.4	7.7	49.8	-	-	-	-	-	-	-	-
Japanese millet (red head),	1	8.90	3.10	36.0	1.5	5.3	45.2	39.5	1.7	5.8	49.6	-	-	-	-	-	-	-	-
Japanese millet hay,	1	18.30	6.90	25.7	1.8	3.7	43.6	31.4	2.2	4.5	53.5	-	-	-	-	-	-	-	-

A. *Composition and Digestibility of Cattle Feeds* — Continued.

NAME.	Analyses.	COMPOSITION.										DIGESTIBILITY.							
		FRESH OR AIR-DRY SUBSTANCE.						WATER-FREE SUBSTANCE.				FRESH OR AIR-DRY SUBSTANCE.				WATER-FREE SUBSTANCE.			
		Water.	Ash.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.
II. Hay and Dry Coarse Fodders — Con.																			
Millet straw,	1	13.40	5.90	36.2	1.2	4.3	39.0	41.8	1.4	5.0	45.0	-	-	-	-	-	-	-	-
Straw (*Panicum crus-galli*),	1	12.60	4.70	31.4	2.1	5.3	43.9	35.9	2.4	6.1	50.2	-	-	-	-	-	-	-	-
Straw (*P. miliaceum*),	1	12.20	5.40	37.1	2.6	3.4	39.3	42.2	3.0	3.9	44.7	-	-	-	-	-	-	-	-
Straw (*P. Italicum*),	1	19.70	5.00	33.3	1.3	3.4	37.3	41.5	1.6	4.2	46.4	-	-	-	-	-	-	-	-
III. Roots, Bulbs, Tubers, etc.																			
Beets, red,	7	87.80	1.10	.7	.1	1.5	8.8	6.0	.9	12.3	72.2	.3	-	1.1	8.0	2.6	-	9.2	65.7
Beets, sugar,	12	85.40	.90	1.0	.1	1.6	11.0	6.6	.7	11.2	75.5	1.0	.05	1.1	10.0	6.6	.35	10.2	75.5
Beets, yellow fodder,	4	88.50	1.00	1.0	.2	1.3	8.0	8.1	1.4	11.7	69.3	.4	-	1.0	7.2	3.3	-	8.8	62.1
Mangolds,	5	87.90	1.20	.8	.1	1.4	8.6	8.5	1.0	9.5	71.0	-	-	1.1	7.8	-	-	7.1	64.6
Ruta-bagas,	3	89.10	1.10	1.3	.2	1.2	7.1	11.8	1.5	11.0	65.9	1.0	.10	1.0	6.7	8.7	1.20	8.8	62.6
Turnips,	5	89.60	.90	1.2	.2	1.1	7.0	11.7	1.8	10.6	67.4	1.2	.20	1.0	6.8	11.7	1.80	9.5	65.4
Carrots,	5	89.00	.90	1.1	.2	1.0	7.8	9.1	2.1	8.8	71.6	-	-	-	-	-	-	-	-

Parsnips,	1	80.40	1.50	1.5	.7	1.3	14.6	7.7	3.4	6.9	74.6	-	-	-	-	-	-	-	-
Potatoes,	14	81.00	1.00	.5	.1	1.9	15.5*	2.6	.5	10.0	81.5†	-	-	.8	14.1	-	-	4.4	74.2
Artichokes,	1	77.50	1.10	.9	.2	2.9	17.4	4.2	1.0	12.8	77.2	-	-	-	-	-	-	-	-
Japanese radish (*merinia*),	1	93.30	.70	.7	.1	.5	4.7	10.3	1.1	7.5	70.8	-	-	-	-	-	-	-	-
Japanese radish (*niyas-hige*),	1	92.60	.70	.7	.1	.5	5.4	9.9	1.0	6.5	72.7	-	-	-	-	-	-	-	-
IV. Grains, Seeds, Fruits, etc.																			
Corn kernels,	29	10.60	1.50	1.9	4.8	10.9	70.3	2.1	5.4	12.2	78.6	-	-	-	-	-	-	-	-
Sweet corn kernels,	1	12.00	1.40	2.1	8.4	11.1	65.0	2.4	9.6	12.6	73.8	-	-	-	-	-	-	-	-
Wheat kernels,	2	10.60	1.80	2.2	1.6	12.0	71.8	2.5	1.8	13.3	80.4	-	-	-	-	-	-	-	-
Oat kernels,	2	11.10	3.10	8.4	5.8	13.2	58.4	9.5	6.5	14.8	65.7	1.7‡	4.1	10.4	43.2	1.9	4.6	11.7	62.6
Broom-corn seed,	1	14.10	2.20	7.1	3.5	9.6	63.5	8.3	4.1	11.2	74.0	-	-	-	-	-	-	-	-
Soja beans,	4	13.00	5.10	5.0	17.2	31.2	28.5	5.7	19.8	35.9	32.8	3.6	14.8	28.4	21.7	4.0	17.0	32.7	24.9
Red adzinki beans,	2	15.90	3.50	3.9	.7	20.6	55.4	4.6	.8	24.5	65.9	2.8	.5	18.1	47.6	3.3	.6	21.6	56.7
Saddle beans,	1	12.40	5.40	4.2	14.5	13.2	50.3	4.8	16.6	15.1	57.3	-	-	-	-	-	-	-	-
Horse beans,	1	10.30	3.90	7.3	.9	26.9	40.7	8.1	1.1	30.0	56.5	5.2	7.7	23.7	37.8	5.8	.9	25.4	52.5
Millet seed,	3	13.30	2.60	7.7	3.7	11.4	61.3	8.9	4.3	13.2	70.6	-	-	-	-	-	-	-	-
Chestnuts,	1	44.90	1.50	1.4	8.0	7.3	36.9	2.5	14.5	13.3	67.0	-	-	-	-	-	-	-	-
Cranberries,	1	89.40	.20	1.2	.6	.5	8.1	11.6	5.6	4.4	76.4	-	-	-	-	-	-	-	-
Apples,	2	77.70	.70	1.5	.5	1.0	18.6	6.6	2.3	4.3	84.7	-	-	-	-	-	-	-	-

* Starch (14 determinations) = 12.9 per cent.

† Starch (14 determinations) = 68.2 per cent.

‡ With horses.

A. *Composition and Digestibility of Cattle Feeds* — Continued.

NAME.	Analyses.	COMPOSITION.										DIGESTIBILITY.							
		FRESH OR AIR-DRY SUBSTANCE.						WATER-FREE SUBSTANCE.				FRESH OR AIR-DRY SUBSTANCE.				WATER-FREE SUBSTANCE.			
		Water.	Ash.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.
V. Flour and Meal.																			
Corn meal,	38	13.60	1.40	1.8	3.3	9.5	70.4	2.1	3.8	11.0	81.5	-	3.0	5.7	65.5	-	3.5	6.6	75.6
Corn and cob meal,	37	10.50	1.40	6.7	3.7	9.0	68.7	7.5	4.2	10.0	76.7	3.1	4.2	5.4	59.6	3.4	4.5	6.0	67.5
Cooked feed (oats and corn),	1	5.50	3.80	8.2	5.0	14.0	63.5	8.7	5.3	14.8	67.2	-	-	-	-	-	-	-	-
Hominy meal,	4	10.00	1.10	29.6	.5	3.2	55.6	32.9	.6	3.6	61.7	-	-	-	-	-	-	-	-
Wheat meal,	1	11.50	2.00	2.9	2.0	12.1	69.5	3.3	2.2	13.7	78.6	-	-	-	-	-	-	-	-
Ground oats,	2	9.30	3.50	8.5	3.6	11.4	63.7	9.3	4.0	12.6	70.2	4.2	3.2	8.0	58.5	4.6	3.6	8.8	64.5
Ground barley,	5	13.10	2.40	5.7	1.9	11.3	65.6	6.5	2.2	13.0	75.5	2.8	1.7	7.9	60.4	3.2	2.0	9.1	69.5
Broom-corn meal,	1	13.50	2.10	6.9	3.5	9.7	64.3	8.0	4.1	11.2	74.3	-	-	-	-	-	-	-	-
Pea meal,	1	8.80	2.60	17.7	1.6	19.2	50.1	19.4	1.7	21.0	55.0	11.7	1.2	17.1	46.6	12.8	1.2	18.6	51.1
Peanut meal,	1	8.00	4.00	3.5	10.8	49.0	25.7	3.8	11.7	53.3	26.9	.8	9.5	44.6	23.6	.9	10.4	48.5	24.7
"Red Dog" flour,	1	9.70	1.90	1.4	4.4	22.6	60.0	1.5	4.9	25.0	66.5	-	-	-	-	-	-	-	-
Bean meal,	1	12.00	1.40	2.1	8.5	11.0	65.0	2.4	9.6	12.6	73.8	1.5	7.3	9.7	60.4	1.7	8.3	10.9	68.6

VI. By-products and Refuse.																			
Linseed meal, old process,	8	9.70	6.20	7.8	6.6	33.1	36.6	8.6	7.3	36.7	40.5	4.4	5.9	29.5	28.6	4.9	6.5	32.7	31.6
Linseed meal, new process,	8	8.30	5.90	8.5	2.9	36.1	37.3	9.3	3.2	39.4	41.7	6.3	2.7	30.7	32.1	6.8	3.0	33.5	35.9
Cotton-seed meal,	32	8.00	6.90	6.84	10.74	41.62	25.9	7.44	11.68	45.24	28.11	2.2	10.0	36.6	16.54	2.38	10.86	39.8	18.0
Cotton-seed bran,	2	9.80	3.10	28.5	3.4	10.6	44.6	31.6	3.8	11.8	49.4	-	-	-	-	-	-	-	-
Wheat bran,	49	10.60	6.80	9.8	4.5	16.1	52.2	10.9	5.0	18.0	58.5	2.2	3.2	14.0	40.4	2.4	3.6	14.0	40.4
Spring wheat bran,	4	10.40	5.70	10.5	5.0	16.0	52.4	11.7	5.6	17.9	58.4	2.5	3.8	12.8	36.6	2.8	4.2	14.3	40.9
Winter wheat bran,	3	11.00	6.00	8.5	2.8	15.1	56.5	9.6	3.2	17.0	63.3	2.3	1.8	11.6	36.7	2.6	2.0	13.1	41.1
Wheat middlings,	9	10.30	5.10	6.8	4.8	15.7	57.3	7.6	5.3	17.5	63.9	2.4	4.1	13.1	50.4	2.7	4.5	14.9	56.2
Rye bran,	2	10.90	3.80	3.6	2.3	15.9	63.5	4.0	2.6	17.8	71.3	-	-	-	-	-	-	-	-
Rye middlings,	1	12.50	3.50	3.3	5.9	11.6	64.2	3.7	5.6	13.2	73.5	-	-	-	-	-	-	-	-
Oat middlings,	1	6.40	4.50	18.3	3.5	11.3	56.0	19.5	3.7	12.1	59.9	-	-	-	-	-	-	-	-
Pea bran,	1	7.10	3.10	42.9	1.1	9.6	36.2	46.2	1.2	10.3	39.0	-	-	-	-	-	-	-	-
Buckwheat middlings,	1	11.50	4.80	4.6	6.6	22.6	49.9	5.2	7.5	25.5	56.4	-	-	-	-	-	-	-	-
Gluten meal,	38	9.00	.90	3.3	8.3	27.3	51.2	3.6	9.1	30.0	56.3	1.0	7.3	23.7	46.6	1.2	8.0	26.1	51.2
Gluten meal (Chicago), old process,	3	9.20	.80	1.1	6.2	30.4	52.2	1.2	6.8	33.5	52.5	-	5.8	27.1	48.4	-	6.5	29.8	53.5
Gluten meal (Chicago), new process,	4	9.60	1.30	2.4	6.0	38.4	42.3	2.6	6.6	42.5	46.8	-	-	-	-	-	-	-	-
Gluten meal (King),	2	7.20	1.70	1.4	19.1	34.6	35.9	1.5	20.6	37.4	38.7	-	18.1	31.8	30.2	-	19.6	34.4	32.5
Gluten feed (Buffalo),	15	8.10	.90	6.8	11.9	23.0	49.3	7.4	12.9	25.0	53.7	5.4	9.6	19.6	39.9	5.9	10.4	21.3	43.5
Gluten feed (Pope),	1	14.00	.70	1.5	14.0	33.2	36.6	1.8	16.3	38.7	42.4	-	-	-	-	-		-	-
Gluten feed (Peoria),	4	7.20	1.20	7.6	12.4	20.5	51.1	8.2	13.4	22.1	55.0	6.0	9.8	17.0	46.0	6.4	10.6	18.3	49.5
Maize feed (Chicago),	5	8.20	.60	7.5	7.1	24.9	51.7	8.2	7.7	27.1	56.3	6.2	6.5	21.2	45.5	6.7	7.1	23.2	49.5

A. *Composition and Digestibility of Cattle Feeds* — Concluded.

NAME.	Analyses.	COMPOSITION.										DIGESTIBILITY.							
		FRESH OR AIR-DRY SUBSTANCE.						WATER-FREE SUBSTANCE.				FRESH OR AIR-DRY SUBSTANCE.				WATER-FREE SUBSTANCE.			
		Water.	Ash.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.	Cellulose.	Fat.	Protein.	Nitrogen-free Extract.
VI. By-products and Refuse — Concluded.																			
Starch feed (Pope),	1	5.50	.80	14.5	10.7	10.7	57.8	15.2	11.3	11.3	61.3	-	-	-	-	-	-	-	-
Atlas gluten meal,	2	9.90	1.10	11.1	12.8	34.3	30.8	12.3	14.2	38.1	34.2	-	12.9	25.0	25.9	-	11.6	27.8	28.7
Glucose feed (Richardson),	1	6.30	1.00	11.0	11.0	21.6	49.1	11.7	11.7	23.1	52.4	-	-	-	-	-	-	-	-
Corn germ meal,	1	9.30	7.60	8.3	10.7	25.7	38.4	9.2	11.8	28.3	42.4	-	-	-	-	-	-	-	-
Corn germ feed,	1	7.50	.80	13.0	11.3	10.0	57.4	14.1	12.2	10.8	62.0	-	-	-	-	-	-	-	-
Corn screenings,	1	11.10	2.10	2.9	4.0	7.4	72.5	3.3	4.5	8.3	81.5	-	-	-	-	-	-	-	-
Proteina (mixed feed),	4	8.40	2.50	10.0	6.6	21.7	50.8	10.9	7.2	23.7	55.5	-	-	-	-	-	-	-	-
Excelsior feed,	1	7.10	4.10	13.7	5.0	9.1	61.0	14.7	5.4	9.8	65.7	-	-	-	-	-	-	-	-
Oat feed,	10	7.50	4.90	13.0	4.3	11.8	58.5	14.1	4.7	12.5	63.4	-	-	-	-	-	-	-	-
Rye feed,	2	8.90	2.70	3.3	2.6	13.8	68.7	3.6	2.9	15.1	75.4	-	-	-	-	-	-	-	-
Cocoa-nut meal,	1	9.30	5.20	17.1	11.7	20.5	36.2	18.8	12.9	22.6	40.0	-	-	-	-	-	-	-	-
Rice meal,	1	9.90	8.40	5.7	13.2	11.6	51.2	6.3	14.6	12.9	56.1	1.5	11.2	7.3	44.0	1.6	12.4	8.1	48.9
Louisiana rice bran,	1	10.20	9.50	13.4	8.7	8.8	49.4	14.9	9.7	9.8	55.0	-	-	-	-	-	-	-	-
Peanut feed,	2	10.00	2.60	56.4	5.5	8.9	16.6	62.7	6.1	9.9	18.4	6.8	5.0	6.3	8.1	7.5	5.4	7.0	9.0

Peanut husks,	1	13.00	1.20	66.0	1.7	5.0	13.1	75.9	1.9	5.7	15.1	-	-	-	-	-	-	-	-
Bakery refuse,	1	13.30	10.10	.3	5.5	8.0	62.8	.4	6.4	9.2	72.4	-	-	-	-	-	-	-	-
Vinegar mash,	1	94.50	.20	.5	.5	.9	3.4	8.6	8.5	16.5	63.4	-	-	-	-	-	-	-	-
Refuse from starch works,	1	57.00	.40	3.2	4.4	9.6	25.4	7.5	10.2	22.4	59.0	-	-	-	-	-	-	-	-
Oat meal and barley refuse,	1	7.80	3.50	20.6	3.5	6.9	57.7	22.3	3.8	7.5	62.6	-	-	-	-	-	-	-	-
Glucose refuse,	1	6.70	1.10	4.5	9.9	19.7	58.0	4.8	10.6	21.1	62.3	-	-	-	-	-	-	-	-
Dried brewers' grain,	4	9.90	4.10	10.2	4.4	21.0	50.4	11.3	4.9	23.3	56.0	5.4	4.0	16.6	39.7	6.0	4.5	18.4	33.0
Malt sprouts,	1	15.40	5.30	12.5	3.3	23.0	40.5	14.8	3.9	27.2	47.8	4.3	3.3	18.4	27.9	5.0	3.9	21.6	33.0
Damaged wheat,	1	13.10	2.00	2.7	2.2	14.2	65.8	3.1	2.5	16.3	75.8	-	-	-	-	-	-	-	-
Cocoa dust,	1	7.10	6.30	5.5	24.1	14.4	42.6	5.9	25.9	15.5	45.9	-	-	-	-	-	-	-	-
Broom-corn waste,	1	8.70	4.50	35.9	.9	6.1	43.9	39.3	1.0	6.8	48.0	-	-	-	-	-	-	-	-
Refuse from cows' manger (ensilage),	6	72.90	2.60	9.4	.4	2.2	12.5	34.6	1.5	8.4	45.9	-	-	-	-	-	-	-	-
Cotton hulls,	3	10.00	2.70	41.5	2.5	4.4	39.0	46.1	2.8	4.8	43.3	19.5	2.2	.3	13.3	21.7	2.2	.4	17.7
Cotton-hull bran,	1	9.60	1.90	35.5	1.1	2.4	49.5	39.3	1.2	2.6	54.7	-	-	-	-	-	-	-	-
Apple pomace,	3	82.80	.40	2.9	.8	1.2	11.9	17.1	4.5	6.8	69.5	-	-	-	-	-	-	-	-
Apple-pomace silage,	1	85.30	.60	3.3	1.1	1.2	8.5	22.2	7.4	8.2	58.0	-	-	-	-	-	-	-	-
Sugar-beet pulp, from diffusion battery,	1	89.70	.10	2.5	.1	1.4	6.2	23.7	1.0	12.4	61.9	-	-	-	-	-	-	-	-
Sugar-beet refuse,	1	28.90	5.30	5.8	.3	8.6	51.1	8.1	.4	12.1	71.9	-	-	-	-	-	-	-	-
Corn cobs,	6	7.60	1.30	31.4	.5	2.7	56.5	34.0	.6	2.9	61.1	20.4	.3	.4	33.9	22.1	.3	.4	36.7
Palmetto root,	1	11.50	3.90	18.9	.4	3.4	61.9	21.3	.5	3.8	70.0	-	-	-	-	-	-	-	-

B. *Fertilizing Ingredients in Fodder Articles.*

[Figures equal percentages or pounds in 100.]

NAME.	Analyses.	Water.	Nitrogen.	Potassium Oxide.	Phosphoric Acid.	Valuation per 2,000 Pounds.*
I. Green Fodders.						
Fodder corn, ...	14	78.6	.41	.33	.15	$1 43
Fodder-corn ensilage, ...	7	80.2	.42	.39	.13	1 52
Corn and soja-bean ensilage, . . .	1	71.0	.79	.44	.42	2 56
Millet and soja-bean ensilage, . . .	5	75.8	.48	.5	.12	1 81
Millet ensilage, ...	3	73.8	.26	.62	.14	1 48
Sorghum, ...	7	82.2	.23	.23	.09	87
Mochi millet, ...	3	62.6	.61	.41	.19	2 06
Millet (*Panicum crus-galli*), . . .	1	75.1	.46	.49	.11	1 70
Green oats, ...	3	83.4	.49	.38	.13	1 58
Green rye, ...	2	72.0	.30	.64	.12	1 48
Vetch and oats, ...	1	86.1	.24	.79	.09	1 93
Horse bean, ...	1	74.7	.68	.35	.08	2 06
Soja bean, ...	1	73.2	.29	.53	.15	1 37
Soja bean (early white), ...	1	66.6	.94	.91	.21	3 37
Soja bean (early green), ...	1	69.8	.84	.71	.20	2 92
Soja bean (medium black), . . .	1	76.9	.80	.57	.18	2 74
Soja bean (late), ...	1	79.7	.60	.68	.14	2 26
Kidney vetch, ...	1	80.9	.56	.35	.09	1 78
Cow-pea vines, ...	1	78.8	.27	.31	.10	1 06
Prickly comfrey, ...	1	86.8	.37	.76	.12	1 77
Serradella, ...	2	82.6	.41	.42	.14	1 54
Common buckwheat, ...	1	84.7	.44	.54	.09	1 69
Flat pea (*Lathyrus sylvestris*), . . .	1	78.6	1.05	.45	.14	3 14
Hungarian grass, ...	1	74.3	.39	.54	.16	1 54
White lupine, ...	1	85.4	.44	.25	.05	1 36
Yellow lupine, ...	1	85.1	.40	.44	.09	1 49
Spanish moss, ...	1	60.8	.28	.26	.03	96
II. Hay and Dry Coarse Fodders.						
English hay, ...	12	11.9	1.32	1.55	.30	5 02
Rowen, ...	13	18.5	1.63	1.50	.44	5 85
Timothy hay, ...	3	11.3	1.24	1.46	.34	4 78
Red top (*Agrostis vulgaris* With.), . .	4	7.7	1.15	1.02	.36	4 14

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* The valuation is based on the following prices per pound of essential fertilizing ingredients: nitrogen, 12 cents; potassium oxide, 5 cents; phosphoric acid, 5 cents.

B. *Fertilizing Ingredients in Fodder Articles* — Continued.

NAME.	Analyses.	Water.	Nitrogen.	Potassium Oxide.	Phosphoric Acid.	Valuation per 2,000 Pounds.*
II. Hay and Dry Coarse Fodders — Con.						
Kentucky blue-grass (*Poa pratensis* L.),	2	5.3	1.32	1.69	.43	$5 29
Orchard grass,	4	8.8	1.31	1.89	.41	5 44
Meadow fescue,	6	8.9	.99	2.10	.40	4 87
Perennial rye-grass,	2	9.1	1.23	1.55	.56	5 06
Italian rye-grass,	4	8.7	1.19	1.27	.56	4 69
Salt hay,	1	5.4	1.18	.72	.25	3 80
Japanese millet (white head),	3	10.5	1.11	1.22	.40	4 28
Common buckwheat,	1	8.5	2.62	3.21	.53	10 02
Silver-hull buckwheat,	1	8.9	1.78	2.38	.86	7 51
Japanese buckwheat,	1	5.7	1.63	3.32	.85	8 08
Fodder corn,	7	7.9	1.76	.89	.54	5 65
Corn stover,	17	9.3	1.04	1.38	.29	4 17
Teosinte,	1	6.1	1.46	3.70	.55	7 75
Summer rape,	1	11.1	2.05	4.67	.57	10 16
Millet hay,	1	9.8	1.28	1.69	.49	5 25
Mammoth red clover,	3	11.4	2.23	1.22	.55	7 12
Medium red clover,	2	7.9	2.18	2.29	.45	7 97
Alsike clover,	6	9.9	2.34	2.23	.67	8 52
Lucerne (alfalfa),	4	6.3	2.08	1.46	.53	6 98
Bokhara clover,	2	7.4	1.98	1.83	.56	7 14
Blue melilot,	1	8.2	1.92	2.80	.54	7 95
Sainfoin,	1	12.2	2.63	2.02	.76	9 09
Sulla,	2	9.4	2.46	2.09	.45	8 36
Lotus villosus,	2	11.5	2.10	1.81	.59	7 44
Soja bean,	2	6.3	2.32	1.08	.67	7 32
Cow pea,	1	9.0	1.64	.91	.53	5 38
Small pea,	1	5.8	2.50	1.99	.59	8 58
Flat pea (*Lathyrus sylvestris*),	1	8.9	3.51	2.34	.82	11 58
Serradella,	2	7.4	2.70	.65	.78	7 91
Scotch tares,	1	15.8	2.96	3.00	.82	10 92
Spring vetch,	1	8.2	2.20	2.76	.74	8 78
Vetch and oats,	3	9.9	1.30	1.35	.56	5 03
Soja-bean straw,	1	13.0	.71	1.06	.26	3 02
Millet straw,	1	13.5	.69	1.76	.18	3 58

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* See note on page 94.

B. *Fertilizing Ingredients in Fodder Articles* — Continued.

NAME.	Analyses.	Water.	Nitrogen.	Potassium Oxide.	Phosphoric Acid.	Valuation per 2,000 Pounds.*
II. Hay and Dry Coarse Fodders — Con.						
White daisy,	1	9.7	.28	1.25	.44	$2 36
Dry carrot tops,	1	9.8	3.13	4.88	.61	13 00
Barley straw,	2	10.0	1.13	2.41	.22	5 34
III. Roots, Bulbs, Tubers, etc.						
Beets, red,	8	87.8	.23	.44	.09	1 08
Beets, sugar,	4	87.0	.22	.48	.10	1 12
Beets, yellow fodder,	1	90.6	.19	.46	.09	1 01
Mangolds,	3	87.6	.15	.34	.14	84
Ruta-bagas,	3	89.1	.19	.49	.12	1 07
Turnips,	4	89.7	.17	.38	.12	81
Carrots,	3	89.0	.16	.46	.09	93
Parsnips,	1	80.3	.22	.62	.19	1 34
Potatoes,	4	80.1	.29	.51	.08	1 29
Artichokes,	1	77.5	.46	.48	.17	1 74
Japanese radish (*merinia*),	1	93.3	.08	.28	.05	52
Japanese radish (*niyas hige*),	1	92.6	.08	.34	.05	58
IV. Grains, Seeds, Fruits, etc.						
Corn kernels,	13	10.9	1.82	.40	.70	5 46
Corn and cob meal,	29	9.0	1.41	.47	.57	4 42
Oat kernels,	1	9.0	2.10	–	–	–
Soja beans,	2	18.3	5.30	1.99	1.87	16 58
Red adzinki beans,	1	14.8	3.24	1.54	.94	10 26
White adzinki beans,	1	16.9	3.33	1.48	.97	10 44
Saddle beans,	1	12.3	2.12	2.13	1.52	8 74
Japanese millet,	1	13.7	1.73	.38	.69	5 22
Common millet,	1	12.7	2.04	.36	.85	6 11
Chestnuts,	1	44.9	1.18	.63	.39	3 85
Cranberries,	1	89.4	.08	.10	.03	32
Apples,	2	79.9	.13	.19	.01	66
V. Flour and Meal.						
Corn meal,	3	14.1	1.92	.34	.71	5 66
Hominy feed,	1	8.9	1.63	.49	.98	5 38
Ground barley,	1	13.4	1.55	.34	.66	4 72
Wheat flour,	2	12.1	2.02	.36	.35	5 56

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* See note on page 94.

B. *Fertilizing Ingredients in Fodder Articles* — Concluded.

NAME.	Analyses.	Water.	Nitrogen.	Potassium Oxide.	Phosphoric Acid.	Valuation per 2,000 Pounds.*
V. *Flour and Meal* — Con.						
Pea meal,	1	8.9	3.08	.99	.82	$9 20
Soja-bean meal,	1	10.8	5.89	2.23	1.57	17 94
Peanut meal,	1	8.0	7.84	1.54	1.27	21 63
VI. *By-products and Refuse.*						
Linseed meal (old process),	4	8.0	5.39	1.21	1.78	15 93
Linseed meal (new process),	5	7.9	5.83	1.25	1.69	16 93
Cotton-seed meal,	24	8.2	6.70	1.83	2.47	20 38
Wheat bran,	10	9.9	2.36	1.40	2.10	9 16
Wheat middlings,	2	10.2	2.75	.75	1.25	8 60
Rye middlings,	1	12.5	1.84	.81	1.26	6 47
Rye feed,	1	9.6	1.95	.98	1.56	7 22
Gluten meal,	5	8.5	5.09	.05	.42	12 69
Gluten feed (Buffalo),	5	8.2	3.72	.06	.34	9 31
Gluten meal (Chicago),	2	9.6	5.75	.06	.43	14 29
Gluten meal (King),	1	7.8	5.69	.08	.69	14 43
Dry distillery feed (Atlas),	1	11.2	5.30	.16	.23	13 50
Dry brewers' grain,	2	8.6	2.68	.85	1.05	8 33
Proteina,	1	10.1	2.97	.57	1.00	8 70
Damaged wheat,	1	13.1	2.26	.51	.83	6 76
Louisiana rice bran,	1	10.3	1.43	.84	1.71	5 98
Glucose refuse,	1	6.7	3.37	.09	.61	8 09
Cocoa dust,	1	7.1	2.30	.63	1.34	7 49
Broom-corn waste (stalks),	1	10.4	.87	1.86	.46	4 41
Cotton hulls,	3	10.6	.75	1.08	.18	3 06
Peanut feed,	2	10.0	1.46	.79	.23	4 52
Peanut husks,	1	13.0	.80	.48	.13	2 53
Meat meal,	1	8.0	11.21	.30	.73	27 93
Apple pomace,	2	80.5	.23	.13	.02	70
Corn cobs,	8	12.1	.50	.60	.06	1 86
Palmetto roots,	1	11.5	.54	1.38	.16	2 83
Buckwheat hulls,	1	11.9	.49	.52	.07	1 77
VII. *Dairy Products.*						
Buttermilk,	1	91.1	.51	.05	.04	1 31
Skim-milk,	22	90.3	.59	-	-	-
Whey,	1	93.7	.10	.07	.17	48

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* See note on page 94.

C. *Analyses of Dairy Products (Per Cent.).*

	Analyses.	Solids.			Fat.			Curd.	Salt.	Ash.
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.			
Whole milk,	1,993	18.27	10.20	13.47	7.54	1.72	4.14	-	-	-
Skim-milk,	351	10.48	7.68	9.48	1.02	.05	.32	-	-	-
Buttermilk,	31	9.86	6.83	8.33	.38	.11	.27	-	-	-
Cream (from Cooley process),	197	32.78	18.12	26.10	25.00	10.53	17.66	-	-	.62
Cream (concentrated commercial),	2	50.12	48.71	49.41	45.37	44.33	44.85	-	-	-
Butter (salted),	38	92.89	85.35	89.21	89.05	81.43	84.34	1.18	3.69	-
Butter (fresh),	14	85.36	72.49	82.24	85.05	72.21	81.48	.76	-	-
Whole-milk cheese (Jersey),*	1	-	-	62.84	-	-	37.32	22.13	-	3.39
Whole-milk cheese,*	1	-	-	64.17	-	-	34.34	26.69	-	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	-	-	62.70	-	-	27.81	30.37	-	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	-	-	57.76	-	-	23.42	31.99	-	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	-	-	56.05	-	-	17.67	33.24	-	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	-	-	54.59	-	-	15.77	34.94	-	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	-	-	51.62	-	-	18.35	28.63	-	4.64
Genuine oleomargarine cheese,*	1	-	-	62.10	-	-	31.66	25.94	-	4.50

* From analyses made in 1875.

Tables of the Digestibility of American Feed Stuffs.

Experiments made in the United States.

Compiled by J. B. LINDSEY.

I. Experiments with Ruminants.

II. Experiments with Swine.

Dec. 31, 1895.

TABLES OF THE DIGESTIBILITY OF AMERICAN FEED STUFFS.

I. EXPERIMENTS WITH RUMINANTS.

KIND OF FODDER.	Number of Different Samples.	Number of Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Hay and Dry Coarse Fodders.								
Timothy hay (in bloom),	3	5	55.6—65.7 60	56.4—66.8 60	55.8—62.1 58	51.5—61.8 57	50.3—60.4 56	57.5—71.8 63
Timothy hay (past bloom),	5	10	47.0—61.1 53	48.4—62.3 54	37.2—56.8 47	34.6—61.1 53	38.8—50.4 45	55.6—66.9 60
Timothy hay (average all trials),	11	25	57	58	52	60	48	63
Hay of mixed grasses (medium in protein*),	1	2	-	-	49	50	40	58
Hay of mixed grasses (rich in protein),	4	14	54—62 58	- -	56—66 60	44—57 49	56—64 59	56—63 59
Rowen (mixed grasses),	1	4	- -	63—67 65	65—68 66	44—50 46	68—70 69	63—68 65
Rowen (chiefly timothy),	1	4	- -	62—67 64	62—73 66	48—51 49	66—69 68	60—65 63
Average (both samples),	-	-	-	65	66	47	68	64
Salt hay of black grass (*Juncus Gerardi*),	1	2	57—62 60	- -	57—64 60	37—46 41	62—63 63	53—59 56
High-grown salt hay (largely *Spartina juncea*),	1	2	51—55 53	- -	46—55 50	42—51 47	62—63 63	52—55 53
Branch grass (*Spartina juncea*, with *Spartina stricta*, var. *glabra*),	1	2	55—57 56	- -	48—56 52	27—36 31	61—63 62	54—55 54
Low meadow fox grass (*Spartina juncea*),	1	2	52—54 53	- -	49—53 51	17—30 24	- 57	51—52 52

Meadow, swale or swamp hay,	1	2	38—40 39	- -	30—36 33	- 44	31—37 34	- 46
Hay of vetch and oats,	1	2	58—58 58	- -	65—67 66	17—20 19	60—61 60	54—54 54
Clover and timothy hay (poorly cured),	1	2	54.3—55.3 55	- -	52—54.4 53	- 58	37.5—37.9 38	- 60
Hungarian hay,	1	2	64.3—65.8 65	65.9—66.8 66	66.8—68.5 68	- 64	- 60	66.9—67.4 67
Hay of blue-joint grass (past bloom) (*Calamagrostis Canadensis*),	1	1	40	42	37	37	57	43
Hay of blue-joint grass (bloom),	1	2	66.7—70.5 69	68.1—71.5 70	71.5—73.4 72	51.4—53.3 52	68.2—72.3 70	66.4—70.9 69
Hay of orchard grass (ten days after bloom),	1	1	54	56	58	54	59	54
Hay of orchard grass (stage not given),	1	2	57.5—60 59	- -	60—66.7 64	55.4—57.4 56	60—60.8 60	55.3—57.3 56
Average of both samples,	2	3	56	56	61	55	60	55
Hay of red top,	2	3	57.6—62.3 60	59.3—63.6 61	60.8—61.8 61	44.2—58.8 51	60.4—62.4 61	59.1—65.2 62
Dried pasture grass,	1	1	71	-	77	60	72	73
Oat straw,	1	2	49—51.7 50	50.8—53.2 52	57.2—58 58	35.5—41 38	- -	51.8—54.6 53
Barley hay,	1	4	59	62	62	41	65	63
Hay of Legumes.								
Soja-bean hay,	1	2	61.9—62.7 62	- -	59.5—62.1 61	18.7—39.7 29	70.1—72.1 71	66.1—71.5 69
Peanut-vine hay,	1	2	59.5—60.2 60	- -	51.2—52.6 52	62.1—69.8 66	63—63.6 63	69.3—69.7 70

* Below 10 per cent.

Table of the Digestibility of American Feed Stuffs — Continued.

KIND OF FODDER.	Number of Different Samples.	Number of Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Hay of Legumes — Concluded.								
Cow-pea-vine hay (fair quality),	1	2	- 59	- -	41.2—44.6 43	46.4—53.7 50	63.9—65.1 65	- 71
Clover hay (late bloom, fair quality),	1	2	54.4—55.5 55	55.9—56.4 56	43.8—49 46	51.8—54.8 53	49.3—59.1 55	63.3—64.8 64
Clover hay (good quality),	1	2	50.8—53.5 52	51.6—54.3 53	46.6—49 48	40—48 43	47—52.2 49	56.8—58.9 58
White clover hay (bloom),	1	1	66	67	61	51	73	70
Scarlet clover hay (*T. incarnatum*),	2	6	56.8—65.4 62	- -	32—58.1 41	35.1—54 44	64—70 66	52—73.6 60
Alsike clover (*T. hybridum*),	2	3	61.1—64.3 62	62—65.2 63	51—58.7 53	35.1—69.3 50	64—69.2 66	66.5—74.1 71
Alfalfa (lucerne) (late bloom),	1	2	-	-	49	54	77	64
Alfalfa (lucerne) (stage not given),	1	1	-	-	43	48	69	72
Corn Fodder (partially Air Dry).								
Corn stover (whole plant),	1	4	61.1—62 62	- -	64.8—68.3 67	48.1—55.8 52	49.6—54.8 52	62.5—64.5 64
Corn stover (tops and blades),	1	2	59—60.5 60	- -	71.1—71.7 71	70.6—71.9 71	54.2—56.6 55	61.9—62.6 62
Corn stover (leaves of),	1	2	54.8—56.2 56	- -	54.3—67 61	60.6—65.4 63	43.1—68.8 56	57.1—60.6 59

Corn stalk (below ear),	1	2	64—69 67	- -	71—75 74	79—80 80	15—27 21	65—73 69
Topped stover (part above ear),	1	2	52—58 55	- -	69—72 71	62—65 64	17—27 22	50—57 54
Corn husks,	1	2	71—73 72	- -	78—81 80	23—42 33	24—35 30	75 -
Corn leaves (below ear),	1	2	62—67 65	- -	75—80 78	52—59 56	28—41 35	66—70 68
Flint corn fodder (ears just forming),	1	3	69—72 70	71—73 71	72—73 72	63—71 67	69—73 70	71—73 71
Flint (mature) field corn fodder,	4	9	68—73 71	71—75 73	69—80 76	59—77 70	59—79 65	69—78 73
Dent (mature) field corn fodder,	5	10	63—70 68	- -	43—61 54	72—82 78	43—61 53	68—81 76
Average both kinds,	-	-	70	-	65	74	59	74
Dent (in milk) field corn fodder,	5	11	58.8—66 63	- -	50—71 64	67—79 75	44—51 50	61—69 66
Dent (immature, Burrill and Whitman, coarse),	1	4	51—64 57	- -	45—74 59	66—84 76	20—36 27	57—66 61
Dent (immature, no ears formed),	4	8	61—70 65	63—71 67	63—77 71	59—72 66	57—67 62	57—70 64
Sweet corn fodder (mature),	3	6	60—71 67	62—74 70	70—77 74	63—71 74	54—73 64	57—73 68
Miscellaneous Dry Substances.								
Hay of wild oat grass (*Danthonica spicata*),	2	3	59.6—68.3 64	61.2—69.1 65	65.1—70.6 68	38.2—62.8 50	48.6—68 58	62.1—68.8 65
Hay of witch grass (*Triticum repens*),	2	4	59.9—62.7 61	61—64.3 62	56.4—67.6 62	53.6—60 57	49.5—64.2 58	62.1—69.9 66
Hay of buttercups (*Ranunculus acris*),	1	2	56	57	41	70	56	67

Table of the Digestibility of American Feed Stuffs — Continued.

KIND OF FODDER.	Number of Different Samples.	Number of Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Miscellaneous Dry Substances — Concluded.								
Hay of white weed (*Leucanthemum vulgare*),	1	2	58	58	46	62	58	67
Cat's-tail millet (*Pennesetum spicatum*),	1	2	61.1—63.6 62	- -	64.7—68.4 67	44.7—47.6 46	60.6—64.6 63	58.3—60 59
Johnson-grass hay,	1	1	55	-	58	39	45	54
Sorghum fodder (leaves),	1	2	59.9—66.3 63	- -	64.9—75.9 70	46.3—47.1 47	59.5—62.2 61	62.5—66.6 65
Sorghum bagasse,	1	1	61	-	64	46	14	65
Cotton-seed hulls (fed alone),	4	13	35—47.5 41	- -	.54—57.6 47	58.2—89.3 79	.00—24.6 6	12.9—45.7 34
Cotton-seed hulls when fed with cotton-seed meal (7 to 1 and 6 to 1),	1	3	41 -	- -	33—40 38	- 78	- -	48—50 49
Cotton-seed hulls when fed with cotton-seed meal (4 to 1 to 1½ to 1),	3	11	43—48 45	- -	43—50 46	66—80 76	- -	49—57 51
Cotton-seed feed (hulls and meal, 7 to 1 and 6 to 1),	1	3	45—46 46	- -	34—40 37	81—82 82	44—46 45	50—51 50
Cotton-seed feed (hulls and meal, 4 to 1 to 1½ to 1),	3	11	52—56 55	- -	43—49 46	84—86 85	61—65 62	49—56 54
Green Fodders.								
Dent corn fodder (immature),	4	11	64—74 68	- -	60—76 67	37—83 68	56—80 66	64—79 71
Dent corn fodder (in milk),	3	9	70	-	64	78	61	76

Dent corn fodder (glazing),	5	9	67	-	51	78	54	75
Dent corn fodder (mature),	2	4	65	-	55	73	51	72
Average (glazing and mature),	7	13	66	-	52	76	53	74
Dent corn fodder (ears glazing, Burrill and Whitman, coarse),	1	2	51—54 52	- -	46—47 46	74—82 78	20—28 24	87—61 59
Sweet corn fodder (milk),	1	2	77—78 77	- -	74—76 75	73—74 74	77—78 77	80—81 81
Early amber sorghum (just after blossom),	1	2	60.9—61.7 61	- -	41.7—45.3 42	67 -	37.7—42.5 40	70.4—70.8 71
Sorghum in blossom (variety not stated),	1	2	73.1—73.3 73	- -	74—75 75	81.3—81.6 81	51.1—55.7 53	78.2—78 78
Average both samples,	2	4	67	-	59	74	46	74
Green grass (young),	1	1	69	-	74	55	65	72
Same (dry),	1	1	71	-	77	60	71	73
Pasture grass,	1	2	71.9—75.6 74	- -	74.6—76.5 76	74—74.9 74	74—76.5 75	73.8—77.1 75
Average of three samples,	-	-	71	-	76	63	70	73
Soiling barley (full bloom),	1	2	- -	62—71 66	49—64 56	61—63 62	69—71 70	69—76 73
Barley and peas (full bloom),	1	2	- -	55—65 60	55—65 60	38—49 44	73—81 77	56—67 61
Soiling rye (formation of head),	1	2	73.2—74 74	- -	78.9—80.4 80	73.6—74.8 74	78.6—79.7 79	69.7—71.4 71
Hungarian grass (probably in bloom),	1	4	61—67 63	63.4—68.8 66	65.4—71.7 68	47.8—56 52	59.4—66.4 62	63.5—68.4 66
Soiling clover (late blossom),	1	2	64.9—67.3 66	- -	52.3—52.9 53	63—66.1 65	65.8—68.3 67	76.1—79.3 78

Table of the Digestibility of American Feed Stuffs — Continued.

KIND OF FODDER.	Number of Different Samples.	Number of Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
Green Fodders — Concluded.								
Scarlet clover (late bloom),	1	3	- -	68—70 69	54—58 56	63—69 66	- 77	74—75 74
Average two samples clover,	2	5	66	67	55	66	73	77
Corn Silage.								
Dent silage (immature),	5	13	60—68 64	- -	71—78 70	64—85 71	42—65 54	60—70 66
Dent silage (milk),	4	12	60—74 65	- -	45—80 64	78—90 87	45—63 52	63—73 69
Dent silage (average of both),	9	26	65	-	68	79	53	67
Dent silage (stage uncertain, North Carolina),	1	4	53—67 60	- -	43—64 56	55—79 70	19—34 24	61—76 68
Flint silage (ears glazing),	4	11	68—78 75	66—80 77	75—79 77	- 82	48—73 65	71—83 79
Fine crushed silage (steers),	1	2	60.4—68 64	- -	72—78 75	75—77 76	32—44 38	60—70 65
Fine crushed silage (sheep),	1	2	51.5—56 54	- -	59.5—67.7 64	67.5—69 68	21—22 21.5	52.6—57.3 55
Corn silage (raw, ears mature),	1	1	-	-	59	86	45	71
Same (cooked),	1	1	-	-	70	87	39	75
Sweet corn ensilage (occasional ears mature),	1	2	66.6—69.6 68	68.5—71.7 70	68.4—73.7 71	82.3—84.6 83	52.7—55.2 54	70.7—73 72
Soja-bean ensilage,	1	2	52.2—65.8 59	- -	47.1—62.5 55	66.4—77.3 72	71.3—80.2 76	45.9—58.2 52

Roots, Tubers, etc.								
Potatoes,	1	3	73.3—80.1 77	74.6—81.2 78	- -	13 -	43.4—45.4 44	87.3—93.4 91
Sugar beets,	1	2	94.2—94.8 95	97.6—99.9 99	88.5—113 100	46.4—53.5 50	90—92.6 91	99.8—100 100
Mangolds,	1	2	77.1—80 79	82.7—87 85	26.8—58.8 43	- -	69.7—79.8 75	90.8—91.9 91
English flat turnips,	1	2	90.7—94.9 93	93.2—99 96	89.2—117 100	82.5—92.5 98	84.5—95 90	96—97 97
Ruta-bagas,	1	2	84.4—90 87	89.2—93 91	61—87.5 74	76.8—91.6 84.2	74.7—85.9 80.3	94.4—95.1 95
Grains and Seeds.								
Corn meal (maize),	2	5	83—98 88	- -	- -	80—98 92	40—77 60	85—100 93
Corn and cob meal,	1	3	74—83 79	- -	2—86 45	82—85 84	43—65 52	86—91 88
Pea meal,	1	2	85—88 87	86—89 88	25—26 26	52—57 55	80—86 83	93—94 94
Raw cotton seed,	1	2	63—69 66	- -	65—86 76	- 87	66—70 68	49—50 50
Roasted cotton seed,	1	2	53—58 56	- -	62—69 66	68—75 72	44—50 47	50—53 51
Soja-bean meal,	1	2	75—82 79	- -	28—50 50	81—90 85	89—91 90	71—73 72
Cotton-seed meal,	2	6	67—82 76	- -	- 32	87—100 93	83—96 88	44—75 64
By-products.								
Gluten meal,	1	2	85—90 87	86—92 89	- 33	86—90 88	83—90 87	88—94 91
Chicago gluten meal,	1	2	87—89 88	- -	- -	92—94 93	87—91 89	93—94 93

Table of the Digestibility of American Feed Stuffs — Concluded.

KIND OF FODDER.	Number of Different Samples	Number of Single Trials.	Dry Matter (Per Cent.).	Organic Matter (Per Cent.).	Crude Cellulose (Per Cent.).	Crude Fat (Per Cent.).	Crude Protein (Per Cent.).	Extract Matter (Per Cent.).
By-products — Concluded.								
King gluten meal,	1	2	79—82 81	- -	- -	91—97 94	- 91	78—81 79
Average gluten meals,	3	6	85	-	-	92	89	88
Buffalo gluten feed (one lot),	1	2	76—80 78	- -	40—46 43	81—82 81	84—86 85	78—84 81
Buffalo gluten feed (another lot),	1	2	87—88 87	- -	84—94 89	92—95 93	87—87 87	87—87 87
Peoria gluten feed,	1	2	84—87 86	- -	59—97 78	76—82 79	81—85 83	90—90 90
Chicago maize feed,	1	2	83—85 84	- -	68—76 72	90—90 90	83—84 84	84—87 85
Winter-wheat bran,	1	3	57—66 62	- -	00—56 27	51—80 64	75—79 77	62—76 65
Spring-wheat bran,	1	2	62—63 63	- -	22—25 24	76—76 76	78—82 80	70—71 70
Average all wheat brans,	4	9	60	63	22	71	78	68
Wheat middlings,*	1	2	72.6—72.2 75	75.1—79.3 77	- -	84.1—86.1 85	78.4—79.4 79	80.7—84.5 83
Wheat middlings,*	1	2	79.48—85.63 83	- -	32.57—40.06 36	81.71—87.98 85	81.83—87.75 85	84.43—91.08 88
New-process linseed meal,	1	3	73—83 80	- -	49—100 74	90—98 93	86—88 85	82—87 84
Old-process linseed meal,	1	3	75—82 79	- -	38—71 57	85—92 89	86—93 89	76—79 78

Atlas meal,	1	2	80—80 80	- -	95—116 106	90—92 91	73—73 73	84—85 84
Rye meal,	1	2	85—90 87	- -	- -	63—65 64	83—85 84	89—94 92
Peanut feed,	1	2	32—32 32	- -	10—13 12	89—90 90	70—71 71	41—58 49
Malt sprouts,	1	1	67	68	34	100	80	69
Dried brewers' grains,	1	2	62—62 62	- -	50—55 53	89—93 91	78—81 79	59—59 59
Corn cobs,	1	2	59—60 59	- -	65—66 65	44—56 50	13—22 17	60—60 60

II. Experiments with Swine.

Maize kernels (whole),	1	1	83	83	38	46	69	89
Maize meal,	2	2	89.5—89.7 90	91.3—92.1 92	29.4—48.7 39	77.6—81.7 80	86.1—89.9 88	93.9—94.2 94
Maize meal (with cobs),	1	1	76	77	29	82	76	84
Pea meal,	1	1	90	92	78	50	89	95
Barley meal,	1	1	80	80	49	57	81	87
Wheat (whole),	1	?	72	-	30	60	70	74
Wheat (cracked),	1	?	82	-	60	70	80	83
Wheat shorts,	1	2	74—79 77	- -	25—48 37	- -	71—75 73	85.5—88 87
Wheat bran,	1	2	53.7—68.6 61	- -	29.6—39.1 34	65.4—78.1 72	74.4—75.8 75	56—75 66

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* Probably different products.

LITERATURE.

The following publications have been consulted in compiling the tables of the digestibility of American feed stuffs: —

Report of Storrs School (Connecticut) Experiment Station, 1894.

Reports of the Maine State Experiment Station for 1886, 1887, 1888, 1889, 1890, 1891, 1893, 1894.

Reports of the New York Experiment Station, 1884, 1888, 1889.

Reports of the Pennsylvania Experiment Station, 1887, 1888, 1889, 1890, 1891, 1892, 1893.

Bulletins Nos. 80 *c*, 81, 87 *d*, 97 and 118 of the North Carolina Experiment Station.

Bulletin No. 16, Utah Experiment Station.

Bulletin No. 3 of the Wisconsin Experiment Station for 1884, and Sixth Annual Report, 1889.

Bulletin No. 8 of the Colorado Experiment Station.

Bulletins Nos. 26 and 36 of the Minnesota Experiment Station.

Bulletin No. 6 of the Oregon Experiment Station.

Bulletins Nos. 13, 15 and 19 of the Texas Experiment Station.

Bulletin No. 20 of the Maryland Experiment Station.

Eleventh and Twelfth Annual Reports (1893 and 1894) of the Massachusetts State Experiment Station.

Report of Hatch Experiment Station, 1895.

REPORT OF THE CHEMIST.

DEPARTMENT OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.

PART I. ON FIELD EXPERIMENTS.

1. Experiments to study the effect of raising leguminous crops in rotation with grain crops on the nitrogen sources of the soil.
2. Observations with mixed forage crops as fodder supply.
3. Experiments to study the economy of using natural phosphates in place of acid phosphates (superphosphates).
4. Experiments to ascertain the influence of different mixtures of chemical fertilizers on the character and yield of garden crops.
5. Experiments to study the effect of phosphatic slag and nitrate of soda as compared with ground bones on field crops.
6. Experiments to study the effect of rotation of manures on permanent grass lands.

PART II. ON THE WORK IN THE CHEMICAL LABORATORY.

1. Report on inspection of commercial fertilizers.
2. Report on general work in the laboratory.
3. Compilation of analyses of manurial substances.
4. Compilation of analyses of fruits, garden crops and insecticides.

PART I.

REPORT ON FIELD EXPERIMENTS.

CHARLES A. GOESSMANN.

1. FIELD EXPERIMENTS CARRIED ON FOR THE PURPOSE OF STUDYING THE EFFECT OF A LIBERAL INTRODUCTION OF CLOVER-LIKE PLANTS — LEGUMINOUS CROPS — INTO FARM PRACTICE, AS A MEANS OF INCREASING THE RESOURCES OF AVAILABLE NITROGEN PLANT FOOD IN THE SOIL UNDER CULTIVATION. (*Field A.*)

The observation of the fact that the different varieties of clover and of clover-like plants in general, as peas, beans, vetches, lupines, etc., are in an exceptional degree qualified, under favorable conditions, to convert, by the aid of certain micro-organisms of the soil, the elementary nitrogen of the air into plant food, imparts to that class of farm crops a special interest from an economical standpoint. This circumstance is in a controlling degree due to the two following causes: —

First. — The nitrogen-containing soil constituents of plant food are as a rule in a high degree liable to suffer serious changes in regard to their character and fitness as well as in reference to their quantity.

Second. — Available nitrogen-furnishing manurial substances are the most costly articles of plant food in our markets.

Field experiments which propose to show by their results to what extent the cultivation of clover-like plants can be relied on as a practical and economical means for securing efficiently nitrogen plant food for the crops to be raised have deservedly of late engaged the most careful attention of agricultural investigators.

The experiments in part described within a few subsequent pages were planned in 1883, and have been continued to the present time upon the same field, with such modification as circumstances advised.

The investigations have been divided into three periods: —

(*a*) Study of the existing soil resources of plant food, 1884 to 1889.

(*b*) Study of the effect of excluding nitrogen plant food from outside sources and of adding nitrogen plant food in various available forms, 1889 to 1892.

(*c*) Studying the effect of the cultivation of leguminous crops on the resources of available nitrogen plant food in the soil under treatment, 1892 to 1896.

The systematic treatment of the field here under consideration, as far as suitable modes of cultivation and of manuring are concerned, was introduced during the season of 1883 to 1884.

The subdivision of the entire area into eleven plats, "one-tenth of an acre each," of a uniform size and shape, 132 feet long and 33 feet wide, with an unoccupied and unmanured space of 5 feet in width between adjoining plats, has been retained unaltered since 1884. A detailed statement of the temporary aim and general management of the experiments, as well as of the results obtained in that connection from year to year, forms a prominent part of my contemporary printed annual reports, to which I have to refer for further details, 1884–95. The first four years of the stated period 1884–89 were principally devoted to an investigation into the general character and condition of the soil under cultivation, as far as its natural and inherent resources of available phosphoric acid, nitrogen and potash were concerned. *The soil proved to be in particular deficient in potash.* Different varieties of corn (maize) were raised in succession to assist in the investigation.

Since 1889 the main object of observation upon the same field has been to study the influence of an entire exclusion of any additional nitrogen-containing manurial substance from the soil under cultivation, as well as of a definite additional supply of nitrogen in different forms of combination on the character and yield of the crop selected for the trial.

Several plats (4, 7, 9) which for five preceding years (1883 to 1889) had not received any nitrogen compound for manurial purposes were retained in that state, to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation; while the remaining ones received, as before, a definite amount of nitrogen in the same form in which they had received it in preceding years, namely, either as sodium nitrate (1, 2), as ammonium sulphate (5, 6, 8), as organic nitrogenous matter in form of dried blood (3, 10) or of barn-yard manure (0). A corresponding amount of available nitrogen was applied in all these cases.

PLATS.	Annual Supply of Manurial Substances.
Plat 0,	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black.
Plat 1,	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 2,	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8 5 lbs. available phosphoric acid).
Plat 3,	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 4,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 5,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 6,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 7,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 8,	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 9,	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 10,	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).

Amount of Fertilizing Ingredients used Annually per Acre.

Plats 0, 1, 2, 3, 5, 6, 8, 10,	Nitrogen,	45 pounds
	Phosphoric acid,	80 pounds.
	Potassium oxide,	125 pounds.
Plats 4, 7, 9,	Nitrogen,	none.
	Phosphoric acid,	80 pounds.
	Potassium oxide,	125 pounds.

The mechanical preparation of the soil, the incorporation of the manurial substances, the seeding, cultivating and harvesting, were carried on year after year in a like manner, and as far as practicable on the same day in case of every plat during the same year.

Kind of Crops raised.

Corn (maize),	in 1889.
Oats,	in 1890.
Rye,	in 1891.
Soja bean,	in 1892.

The annual yield of the various crops upon the different plats showed that as a rule those plats (4, 7, 9) which had not received in any form nitrogen for manurial purposes yielded much smaller crops than those that annually received in some form or other an addition of a corresponding amount of available nitrogen.

The results of four years of careful observation were expressed in the following conclusion: —

The experiments carried on upon Field A during the years 1889, '90, '91 and '92 show conclusively the importance of a liberal supply to the soil of an available form of nitrogen to secure a successful and remunerative cultivation of farm crops under otherwise corresponding favorable conditions. For even a leguminous crop, the soja bean, when for the first time raised upon Field A, did not furnish an exception to our observation (1892). (For details, see report for 1892.)

Subsequent to the year 1892, when for the first time in the more recent history of the field under discussion a leguminous crop, a late-maturing variety of soja bean, had been raised upon it, our attention had been directed chiefly to the question, To what extent does the cultivation of soja bean, a clover-like plant, benefit the resources of available nitrogen plant food of the soil after the removal of the crop at the close of the season (for ensilage)?

It seemed of interest in our case to ascertain whether the raising of the soja bean upon Field A had increased the amount of available nitrogen stored up in the soil to such an extent as to affect the yield of succeeding crops upon those plats (4, 7, 9) which, as a rule, did not receive at any time for eight successive years an addition of available nitrogen from any other manurial source but the atmospheric air and the roots left in the soil after harvesting the crops raised.

A grain crop (oats) was selected as the crop suitable to serve for that purpose. The general management of the experiment, as far as the preparation of the soil, manuring and seeding-down are concerned, was the same as in preceding years (see tenth annual report).

An examination of the yield of the crop in 1893, secured upon the different plats, showed that the total crop per acre on those plats to which no nitrogen was applied (4, 7, 9) averaged 800 pounds less than in case of the plats which received their regular supply of nitrogen in some form or other.

Ratio of Grain to Straw (1893).

Plat 0,	1:3	Plat 6,	1:4.9
Plat 1,	1:4.1	Plat 7,	1:3.6
Plat 2,	1:3.1	Plat 8,	1:3.4
Plat 3,	1:3.2	Plat 9,	1:3.4
Plat 4,	1:2.7	Plat 10,	1:3.9
Plat 5,	1:7		

The best results in relation of total yield to yield of grain were obtained in case of those plats receiving organic nitrogen (dried blood and barn-yard manure) or nitrogen in the form of nitrate of soda; while in the case of sulphate of ammonia the ratio of grain to straw was too wide to be satisfactory.

The total yield of crops on the plats receiving no nitrogen addition, as compared with those receiving a nitrogen supply, was during succeeding years as follows: —

With corn in 1889, one-fifth less.
With oats in 1890, one-fifth to one-sixth less.
With rye in 1891, one-fifth to one-sixth less.
With soja bean in 1892, one-third to one-fourth less.
With oats in 1893, one-seventh to one-eighth less.

From these results it appeared that the introduction of a leguminous crop into our rotation had somewhat reduced the difference in yield between the plats receiving no nitrogen and those receiving it, yet had not entirely obliterated it. It was decided to continue the observation by repeating the raising of soja beans in 1894 and oats in 1895.

1894. — To secure, if possible, more decisive results regarding the presence and absence of available nitrogen, it was decided to use twice the amount of phosphoric acid and potassium oxide, as compared with preceding years.

Amount of Fertilizing Ingredients applied per Acre during 1894.

Plats 0, 1, 2, 3, 5, 6, 8, 10,	Nitrogen,	45 pounds.
	Phosphoric acid,	160 pounds.
	Potassium oxide,	250 pounds.
Plats 4, 7, 9,	Nitrogen,	none.
	Phosphoric acid,	160 pounds.
	Potassium oxide,	250 pounds.

An early-maturing variety of soja bean was selected for the experiments. The fertilizer mixtures were applied as in previous years, broadcast, in the middle of April.

After proper preparation of the soil the soja beans were planted on May 12 in drills two and one-half feet apart, 6 pounds of seed being used per plat, or 60 pounds per acre. The plants appeared above ground May 21; June 5 the field was cultivated and hoed, and also on the 16th, 25th and July 12.

The plants began to bloom July 25. Owing to the protracted drought of July and August, the crop did not get that fulness of growth which might have been obtained under more favorable conditions. The crop was cut August 28.

Yield of Soja Bean when cut on Different Plats (1894).

[Pounds.]

PLATS.	Per Plat.
Plat 0,	600
Plat 1,	625
Plat 2,	700
Plat 3,	525
Plat 4,	405
Plat 5,	645
Plat 6,	615
Plat 7,	480
Plat 8,	680
Plat 9,	470
Plat 10,	570

	Per Cent.
Dry matter,	34
Moisture,	66

Conclusions.

1. A comparison of the above-stated yield of the different plats shows that those plats (4, 7, 9) which received no nitrogen addition from an outside source yielded on an average 452 pounds each, while those plats which received an addition of available nitrogen plant food, 45 pounds of nitrogen per acre, yielded on an average 620 pounds each, — a difference of one-third in favor of the latter.

2. An increase to twice the amount of phosphoric acid and potassium oxide, as compared with earlier years (see report for 1892), had not changed the relative yield of the crop, as noticed in case of the late soja bean in 1892.

1895. — Oats were again selected to succeed the soja bean of the preceding season, for the purpose of admitting a direct comparison of the results of 1894 and 1895 with those obtained under corresponding circumstances during the years 1892 and 1893, when the same crops followed each other in the same order.

The field was ploughed April 29; the fertilizers were applied April 30, in the same manner and in the same quantity to each plat as in the preceding year (1894), specified upon a previous page, namely, per acre: —

Plats 4, 7, 9,	Nitrogen,	None.
	Phosphoric acid,	160 pounds.
	Potassium oxide,	250 pounds.
Plats 0, 1, 2, 3, 5, 6, 8, 10,	Nitrogen,	45 pounds.
	Phosphoric acid,	160 pounds.
	Potassium oxide,	250 pounds.

The oats were sown in drills two feet apart, at the rate of 7 pounds per plat, or 70 pounds per acre, on May 7. The young plants showed above ground on all plats alike May 11.

To secure clean culture the cultivator was used twice, May 29 and June 12. The crop did not mature at the same time upon all plats, and was for that reason cut at different dates. It was cut when matured, on August 2 upon plats 0, 1, 2, 3, 4, 7, 9, 10, on August 8 upon plats 5 and 8 and on August 17 upon Plat 6. From this data it will be noticed that in all cases where sulphate of ammonia was used as the nitrogen supply for the raising of oats the maturing of the crop was from one to two weeks later than on all other plats, where either nitrate of soda or organic nitrogen compounds, as blood, barn-yard manure or no nitrogen-containing manurial matter, was applied. Similar results have been noticed in previous years, when summer grain crops have been raised in connection with the experiment under discussion.

Yield of Field A, Oats (1895).

[Pounds.]

PLATS.	Oats.	Straw.	Total Weight.
Plat 0,	134	254	388
Plat 1,	160	330	490
Plat 2,	150	330	480
Plat 3,	149	331	480
Plat 4,	110	233	343
Plat 5,	190	360	550
Plat 6,	155	405	560
Plat 7,	136	292	428
Plat 8,	92	458	550
Plat 9,	123	217	340
Plat 10,	169	381	550

	Per Cent.
Moisture, oats,	14.60
Moisture, straw,	15.90

Summary of Yield of Oats (1893, 1895).

[Pounds.]

PLATS.	1893.			1895.		
	Weight of Grain.	Weight of Straw and Chaff.	Total Weight.	Weight of Grain.	Weight of Straw and Chaff.	Total Weight.
Plat 0,	131	399	530	134	254	388
Plat 1,	135	555	690	160	330	490
Plat 2,	146	454	600	150	330	480
Plat 3,	166	534	700	149	331	480
Plat 4,	160	430	590	110	233	343
Plat 5,	79	551	630	190	360	550
Plat 6,	102	498	600	155	405	560
Plat 7,	119	431	550	136	292	428
Plat 8,	95	325	420	92	458	550
Plat 9,	110	370	480	123	217	340
Plat 10,	125	485	610	169	381	550

Ratio of Grain to Straw (1893, 1895).

PLATS.	1893.	1895.
Plat 0,	1:3	1:1.9
Plat 1,	1:4.1	1:2.06
Plat 2,	1:3.1	1:2.2
Plat 3,	1:3.2	1:2.2
Plat 4,	1:2.7	1:2.1
Plat 5,	1:7	1:1.9
Plat 6,	1:4.9	1:2.6
Plat 7,	1:3.6	1:2.14
Plat 8,	1:3.4	1:4.97
Plat 9,	1:3.4	1:1.76
Plat 10,	1:3.9	1:2.25

Average Yield of Oats on Plats receiving no Nitrogen and on Plats receiving Nitrogen (1893, 1895).

[Pounds.]

PLATS.	1893.	1895.
Plats 4, 7 and 9 (no nitrogen),	540.0	370.3
Plats 0, 1, 2, 3, 5, 6, 8 and 10 (receiving nitrogen),	597.5	506.0

Conclusions.

The conditions of the different plats are apparently materially the same to-day as they were two years ago. The raising of soja beans has not changed the results for the better. It remains to be seen whether the ploughing under of a leguminous crop, serving as green manure, will affect the results.

2. OBSERVATIONS WITH THE CULTIVATION OF MIXED FORAGE CROPS. (*Field B.*)

The importance of a more liberal supply of nutritious forage crops for an economical support of dairy stock is quite generally recognized by all parties interested. To assist in the solution of that question induced the writer to devote for a series of years special attention to the raising of fodder crops of a high nutritive character and of a liberal yield. Mixed forage crops, consisting of early maturing annual leguminous crops, clover-like plants and of either oats or barley, suggested themselves for a trial; for they attain a high feeding value at a comparatively early period of the season, — towards the end of June when in bloom; they can serve with benefit in form of green fodder, hay or ensilage, as circumstances advise, and they yield under fair conditions large quantities. Experiments with peas, Scotch tares and vetches have been already described in previous reports. The results obtained induced the writer to prefer summer vetch (*vicia sativa*) to both peas and tares, in case of mixed crops. The fields used for the observation were located in different parts of the farm; they were as a rule in a fair state of cultivation, as far as the mechanical condition of the soil as well as its store of plant food was concerned. The soil consisted in the majority of cases of a somewhat gravelly loam.

Vetch and Oats.

1893. — Half an acre of a field which had served during the preceding year for the production of root crops, carrots and sugar beets was fertilized April 26 with 300 pounds of fine-ground bone and 100 pounds of muriate of potash. The fertilizer was applied broadcast and subsequently ploughed in May 8; the field was sown with oats and summer vetch, using 2 bushels of oats and 25 pounds of vetch. The seeds were sown each by itself, on account of the great difference in size and general character. The crop made an even and rapid growth. The oats headed out at the time when the vetch began to bloom. At this stage of growth the feeding as green fodder began, July 6. It was continued until the oats turned yellowish, July 18. The remainder of the crop was then cut for hay. The total yield of the crop, counted as green fodder, with 20 per cent. of dry vegetable matter, amounted to 21,000 pounds per acre. Buckwheat was subsequently raised upon the same field as fall crop.

1894. — The field in this case was 700 feet long and 75 feet wide, equal to one and one-fifth acres (corn was raised upon it in 1893). It was ploughed Oct. 25, 1893, and manured with barn-yard manure at the rate of ten tons per acre; and was ploughed again April 18, 1894, and harrowed and subsequently seeded with oats and vetch, as described in the preceding experiment, using 4 bushels of oats and 45 pounds of vetch per acre. The seeds were, however, sown at two different times, to extend the period of the fitness of the crop for green fodder. The seed sown on the northern portion April 20 came up April 28. The southern portion of the field was seeded May 11, the plants appearing above ground May 19. The crop made a very satisfactory growth, and on June 23 the feeding of the green material from the northern portion began (the vetch being in bloom and the oats heading out), continuing until July 2, when the remainder was cut for hay. July 6 the cutting from the southern portion began, continuing until the 18th, when that remaining was cut for hay. Following is given a statement of the yield from the field: —

	Pounds.
Green material fed (19.12 per cent of dry matter), .	6,875
Hay of vetch and oats (73.66 per cent. of dry matter),	4,980

July 21 the field was ploughed and prepared for raising upon it, as a fall crop, Hungarian grass.

During the same year (1894) other observations of a similar character as previously described were carried on in other parts of the farm.

It was decided to compare the effect of muriate of potash and sulphate of potash on mixed crops, consisting of oats and vetch and of barley and vetch. The field used for this observation consisted of a light loam. It had been used during the preceding season for the cultivation of different varieties of potatoes, and had received as manure on that occasion, per acre, in one case, 400 pounds of high-grade sulphate of potash (95 per cent.), with 600 pounds of fine-ground bone; in the other, 400 pounds of muriate of potash (80–82 per cent.), with 600 pounds of fine-ground bone. The same amount and kind of manure were applied for raising vetch and oats and vetch and barley. The field occupied by these crops was ploughed, manured, harrowed and seeded down, as far as practicable, at the same time. The seed was sown in all cases April 26. Four bushels of oats with 45 pounds of vetch were sown, as on previous occasions, while 3 bushels of barley were used, with 45 pounds of vetch, in case of barley and vetch. Both crops came up May 4, and were of a uniformly healthy condition during their subsequent growth. The barley began to head out June 20; the vetch was at that time beginning to bloom. The crop was cut for hay June 23.

Yield of Barley and Vetch per Acre.

In case of muriate of potash and bone, . .	5,737 pounds of hay.
In case of sulphate of potash and bone, . .	5,077 pounds of hay.

The oats headed out June 25; the vetch was fairly in bloom. The crop was cut for hay July 2.

Yield of Oats and Vetch per Acre.

In case of muriate of potash and bone, . .	8,051 pounds of hay.
In case of sulphate of potash and bone, . .	7,088 pounds of hay.

1895. — During that year the observations of the preceding year were repeated and in some directions enlarged upon. Aside from mixed forage crops of vetch and oats and vetch and barley, there were raised crops consisting of oats, vetch and horse bean and of oats and lentils. The field used for these experiments had been used during the preceding season either for the cultivation of potatoes or of vetch and oats. In both cases it had been manured, per acre, with either 400 pounds of muriate of potash and 600 pounds of fine-ground bone, or with 400 pounds of sulphate of potash and 600 pounds of fine-ground bone. The same kind and the same quantity of manure were applied in 1895. The field was ploughed April 25; the manure harrowed in

May 3; the seed was sown broadcast May 9. All parts of the field were treated alike, and as far as practicable on the same day. The plats occupied by the crops were in all cases 33 feet wide, with 4 feet unoccupied space between them, and from 191 to 241 feet long. The yield of areas 175 feet long and 33 feet wide, running along by the side of each other, served as our basis for comparing results (5,775 square feet).

The seed was sown May 9, at the rate of 4 bushels of oats and 45 pounds of vetch per acre. The oats came up May 16, and the vetch May 21; the former headed out July 6, and the vetch began blooming at that time. The crop was cut for hay July 16.

Yield of Vetch and Oats per Acre.

In case of muriate of potash and bone, ...	7,238 pounds.
In case of sulphate of potash and bone, ...	6,635 pounds.

Vetch, Horse Bean and Oats.

The seed was sown May 9, at the rate of 40 pounds of vetch, 120 pounds of horse bean (medium sized) and 3 bushels of oats. The oats came up May 16, the vetch on May 21 and the horse bean May 23. The crop appeared healthy and vigorous at every stage of growth. It was cut for hay July 22, when the oats were fairly headed and the remainder in bloom.

Yield of Vetch, Horse Bean and Oats per Acre.

In case of muriate of potash and bone, ...	7,398 pounds.
In case of sulphate of potash and bone, ...	5,881 pounds.

Lentils and Oats.

The seed was sown May 9, at the rate of 60 pounds of lentils and 4 bushels of oats per acre. The oats came up May 16, and the lentils on May 21; the former headed out July 6, when the latter were fairly in bloom. The crop was cut for hay July 16. The experiment was confined to a trial with sulphate of potash and bone as manure on account of want of a suitable field.

Yield of lentils and oats per acre, . . .	5,881 pounds of hay.

Composition of Mixed Forage Crops raised, 1893 to 1896.

Green crop when cut contains: —

Moisture,	76 to 80 per cent.
Dry matter,	20 to 24 per cent.

Analyses of Vetch and Barley (Equal Number of Plants of Each).

[Per Cent.]

	Muriate of Potash.	Sulphate of Potash.
Moisture at 100° C.,	78.23	77.70
Dry matter,	21.77	22.30
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	4.64	7.80
" fibre,	32.25	32.58
" fat,	2.12	2.56
" protein,	14.44	13.36
Nitrogen-free extract matter,	46.55	43.70
	100.00	100.00

Analyses of Vetch and Oats (Equal Number of Plants of Each).

[Per Cent.]

	Muriate of Potash.	Sulphate of Potash.
Moisture at 100° C.,	76.24	75.29
Dry matter,	23.76	24.71
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	9.59	8.69
" fibre,	29.83	31.28
" fat,	3.13	2.63
" protein,	18.88	15.16
Nitrogen-free extract matter,	38.57	42.24
	100.00	100.00

Analysis of Vetch, Oats and Horse Bean (Muriate of Potash).

[Three plants each of vetch and of oats and one of horse bean.]

	Per Cent
Moisture at 100° C.,	82.13
Dry matter,	17.87
	100.00

Analysis of Dry Matter.

Crude ash,	10.36
" cellulose,	30.07
" fat,	2.70
" protein,	18.93
Nitrogen-free extract matter,	37.94
	100.00

Analysis of Lentils and Oats.

	Per Cent.
Moisture at 100° C.,	78.50
Dry matter,	21.50
	100.00

Analysis of Dry Matter.

Crude ash,	5.40
" cellulose,	34.90
" fat,	2.40
" protein,	14.90
Nitrogen-free extract matter,	42.40
	100.00

Conclusions.

From the above analyses it appears that vetch and oats lead vetch and barley, on account of the larger and more foliaceous character of the oats as compared with the barley. Vetch, oats and horse bean lead in nitrogenous matter, and no doubt will exceed in regard to the nutritious character of the crop as soon as the amount of horse bean has been doubled, as indicated above. Every one of these crops compares well with clover hay, as far as its nutritive value is concerned. The large yield of these crops per acre, their high nutritive value and special adaptation for green fodder, hay or ensilage, merit serious attention for the support of farm and dairy stock. The early date of maturity presents exceptionally good chances of raising a second crop for fall supply of fodder, or for a timely preparation of the soil for winter crops. Feeding experiments carried on for several years at the station with these crops have fully established their high nutritive character for dairy stock, as well as other farm live stock ordinarily depending on the product of the meadow and pasture.

3. FIELD EXPERIMENTS WITH DIFFERENT COMMERCIAL PHOSPHATES, TO STUDY THE ECONOMY OF USING THE CHEAPER NATURAL PHOSPHATES OR THE MORE COSTLY ACIDULATED PHOSPHATES. (*Field F.*)

The field selected for this purpose is 300 feet long and 137 feet wide, running on a level from east to west. Previous to 1887 it was used as a meadow, which was well worn out at that time, yielding but a scanty crop of English hay. During the autumn of 1887 the sod was turned under and left in that state over winter. It was decided to prepare the field for special experiments with phosphoric acid by a systematic exhaustion of its inherent resources of plant food. For this reason no manurial matter of any description was applied during the years 1887, 1888 and 1889.

The soil, a fair, sandy loam, was carefully prepared every year by ploughing during the fall and in the spring, to improve its mechanical condition to the full extent of existing circumstances. During the same period a crop was raised every year. These crops were selected, as far as practicable, with a view to exhaust the supply of phosphoric acid in particular. Corn, Hungarian grass and leguminous crops (cow-pea, vetch and serradella) followed each other in the order stated.

1890. — The field was subdivided into five plats, running from east to west, each 21 feet wide, with a space of 8 feet between adjoining plats. The manurial material applied to each of these five plats contained, in every instance, the same form and the same quantity of potassium oxide and of nitrogen, while the phosphoric acid was furnished in each case in the form of a different commercial phosphoric-acid-containing article, namely, phosphatic slag, Mona guano, Florida phosphate, South Carolina phosphate (floats) and dissolved bone-black. The market cost of each of these articles controlled the quantity applied, for each plat received the same money value in its particular kind of phosphate. The phosphatic slag, Mona guano, South Carolina phosphate and Florida phosphate were applied at the rate of 850 pounds per acre, dissolved bone-black at the rate of 500 pounds per acre. Nitrate of soda was applied at the rate of 250 pounds per acre and potash-magnesia sulphate at the rate of 390 pounds per acre.

Cost per Ton.

Phosphatic slag,	$15 00
Mona guano (West Indies),	15 00
Florida rock phosphate,	15 00
South Carolina phosphate (floats),	15 00
Dissolved bone-black,	25 00

Analyses of Phosphates used.

[I., phosphatic slag; II., Mona guano; III., Florida phosphate; IV., South Carolina phosphate; V., dissolved bone-black.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture,	0.47	12.52	2.53	0.39	15.96
Ash,	–	75.99	89.52	–	61.46
Calcium oxide,	46.47	37.49	17.89	46.76	–
Magnesium oxide,	5.05	–	–	–	–
Ferric and aluminic oxides,	14.35	–	14.25	5.78	–
Total phosphoric acid,	19.04	21.88	21.72	27.57	15.82
Soluble phosphoric acid,	–	–	–	–	12.65
Reverted phosphoric acid,	–	7.55	–	4.27	2.52
Insoluble phosphoric acid,	–	14.33	–	23.30	0.65
Insoluble matter,	4.39	2.45	30.50	9.04	6.26

The following fertilizer mixtures have been applied annually, from 1890 to 1894, to all the plats, with the exception of Plat 3, which received in 1890 ground apatite and in 1891 no phosphate whatever, on account of the failure of securing in time apatite suitable for the trial.

Plats.	Annual Supply of Manurial Substances.	Pounds.
Plat 1 (south, 6,494 square feet),	Ground phosphatic slag,	127
	Nitrate of soda,	43
	Potash-magnesia sulphate,	58
Plat 2 (6,565 square feet),	Ground Mona guano,	128
	Nitrate of soda,	43½
	Potash-magnesia sulphate,	59
Plat 3 (6,636 square feet),	Ground Florida phosphate,	129
	Nitrate of soda,	44
	Potash-magnesia sulphate,	59
Plat 4 (6,707 square feet),	South Carolina phosphate,	131
	Nitrate of soda,	44½
	Potash-magnesia sulphate,	60
Plat 5 (6,778 square feet),	Dissolved bone-black,	78
	Nitrate of soda,	45
	Potash-magnesia sulphate,	61

The field was ploughed as a rule during the month of October, and again at the close of the month of April. The fertilizer was in each case applied broadcast soon after ploughing in the spring. The seed was sown in hills or drills, as circumstances advised, and the crop kept clean from weeds by the use of the hoe or the cultivator. The following crops were raised : —

1890, potatoes (see eighth annual report).
1891, winter wheat (see ninth annual report).
1892, serradella (see tenth annual report).
1893, Dent corn, Pride of the North (see eleventh annual report).

Summary of Yield of Crops (Pounds).

PLATS.	1890. Potatoes.	1891. Wheat.	1892. Serradella.	1893. Corn.
Plat 1, phosphatic slag,	1,600	380	4,070	1,660
Plat 2, Mona guano,	1,415	340	3,410	1,381
Plat 3, Florida phosphate,	1,500	215	2,750	1,347
Plat 4, South Carolina floats,	1,830	380	3,110	1,469
Plat 5, dissolved bone-black,	2,120	405	2,920	1,322

Having for four years (1890–94) in succession pursued the above-stated system of manuring each plat with a different kind of phosphate, yet of corresponding money value, it was decided to continue the experiments for the purpose of studying the after-effect of the different phosphates on the crops to be raised. To gain this end the phosphates were hereafter in all cases entirely excluded from the fertilizers applied ; in addition to this change, the former amount of potash and nitrogen was increased one-half in quantity, to favor the highest effect of the stored-up phosphoric acid of the soil under treatment.

The fertilizers hereafter to be used had the following composition : —

Plat 1 (6,494 square feet),	64½ pounds of nitrate of soda. 87 pounds of potash-magnesia sulphate.
Plat 2 (6,565 square feet),	65¼ pounds of nitrate of soda. 88 pounds of potash-magnesia sulphate.
Plat 3 (6,636 square feet),	66 pounds of nitrate of soda. 89 pounds of potash-magnesia sulphate.
Plat 4 (6,707 square feet),	66¾ pounds of nitrate of soda. 90 pounds of potash-magnesia sulphate.
Plat 5 (6,778 square feet),	67½ pounds of nitrate of soda. 90½ pounds of potash-magnesia sulphate.

The results of two seasons (1894 and 1895) are as follows: —

Barley.

Yield of Crop (1894).

Plats.	Grain and Straw (Pounds).	Grain (Pounds).	Straw and Chaff (Pounds).	Percentage of Grain.	Percentage of Straw.
Plat 1, ...	490	169	221	34.49	65.51
Plat 2, ...	405	148	251	34.07	65.93
Plat 3, ...	290	78	212	26.89	73.11
Plat 4, ...	460	144	216	31.30	68.70
Plat 5, ...	390	118	272	30.26	69.74

Rye.

Yield of Crop (1895).

Plats.	Grain and Straw (Pounds).	Grain (Pounds).	Straw and Chaff (Pounds).	Percentage of Grain.	Percentage of Straw.
Plat 1, ...	695	195	500	28.06	71.94
Plat 2, ...	631	166	465	26.31	73.69
Plat 3, ...	383	143	240	37.34	62.66
Plat 4, ...	759	189	570	24.90	75.10
Plat 5, ...	625	185	440	29.60	70.40

Summary of Yield of Crop (1890 to 1896).

[Pounds.]

Plats.	**1890.** Potatoes.	**1891.** Wheat.	**1892.** Serradella.	**1893.** Corn.	**1894.** Barley.	**1895.** Rye.
Plat 1.	1,600	380	4,070	1,660	490	695
Plat 2, ...	1,415	340	3,410	1,381	405	630
Plat 3, ...	1,500	215	2,750	1,347	290	383
Plat 4, ...	1,830	380	3,110	1,469	460	759
Plat 5, ...	2,120	405	2,920	1,322	390	625

Conclusions.

From the previous statement of comparative yield we find that the plat receiving dissolved bone-black leads in yield during the two first years, while for the third, fourth, fifth and sixth years the plats receiving insoluble phosphates are ahead, phosphatic slag being first, South Carolina floats second and Mona guano third.

The following statement regarding the amount of phosphoric acid applied in the case of each plat, and also the amount removed from them by the crops raised, shows approximately how much of the former is still stored up in the soil in each plat.

Phosphoric Acid applied to and removed from Field (Pounds).

PLATS.	1890. Potatoes.		1891. Wheat.		1892. Serradella.		1893. Corn.		Total Amount added.	Total Amount removed.	Total Amount remaining.
	Added.	Removed.	Added.	Removed.	Added.	Removed.	Added.	Removed.			
Plat 1, .	24.18	2.56	24.18	1.23	24.18	8.95	24.18	7.20	96.72	19.94	77.78
Plat 2, .	28.01	2.36	28.01	1.19	28.01	7.50	28.01	6.33	72.04	17.38	54.66
Plat 3, .	109.68	2.40	–	.69	28.01	6.05	28.01	5.95	165.70	15.09	150.61
Plat 4, .	36.12	2.93	36.12	1.31	36.12	6.84	36.12	6.68	144.48	18.12	126.36
Plat 5, .	12.34	3.39	12.34	1.22	12.34	6.42	12.34	6.05	49.36	17.08	32.28

Phosphoric Acid applied to and removed from Field (Pounds) — Concluded.

PLATS.	1894. — Barley.		1895. — Rye.		Total Amount added.	Total Amount removed.	Total Amount remaining.
	Added.	Removed.	Added.	Removed.			
Plat 1, ...	None.	1.92	None.	3.41	96.72	25.27	72.45
Plat 2, ...		1.64		3.04	72.04	22.06	49.98
Plat 3, ...		.76		2.06	165.70	17.91	147.79
Plat 4, ...		1.72		3.61	144.48	23.45	121.03
Plat 5, ...		1.49		3.11	49.36	21.68	27.68

The amount of phosphoric acid left in the soil at the close of the season of 1895 is lowest in Plat 5, where dissolved bone-black, the most costly phosphate used in the experiment, has served as its source. The experiment will be continued until a final answer is obtained.

4. FIELD EXPERIMENTS TO ASCERTAIN THE INFLUENCE OF DIFFERENT MIXTURES OF COMMERCIAL FERTILIZERS ON THE YIELD AND GENERAL CHARACTER OF SEVERAL PROMINENT GARDEN CROPS.

The area devoted to the above-stated experiment is 198 feet long and 183 feet wide; it is subdivided into six plats of uniform size (89½ by 62 feet, or about one-eighth of an acre each). The plats are separated from each other and from the adjoining cultivated fields by a space of 5 feet of unmanured and unseeded yet cultivated land. They are arranged in two parallel rows, running from west to east. Nos. 1, 2 and 3 are along the north side of the field, beginning with No. 1 at its west end, while plats Nos. 4, 5 and 6 are located along its south side, beginning with Plat 4 on the west end. The soil is several feet deep, and consists of a light, somewhat gravelly loam, and was in a fair state of productiveness when assigned for the experiment here under consideration. The entire field occupied by the experiment is nearly on a level. Potatoes and a variety of forage crops had been raised upon it in preceding years. The manure applied since 1885 has consisted exclusively of fine-ground bone and muriate of potash, annually, 600 pounds of the former and 200 pounds of the latter per acre.

The observation with raising garden crops, by the aid of different mixtures of commercial manurial substances, here under special consideration, began upon plats Nos. 4, 5 and 6 during the spring of 1891, and upon plats 1, 2 and 3 during that of 1892.

The difference of the fertilizers applied consisted in the circumstance that different forms of nitrogen and potash were used for their preparation. All plats received essentially the same quantity of nitrogen, potash and phosphoric acid, and every one of them received its phosphoric acid in the same form, namely, dissolved bone-black. Some plats received their nitrogen supply in the form of organic animal matter, dried blood; others in the form of sodium nitrate, Chili saltpetre; others in the form of ammonium sulphate. Some plats received their potash in the form of muriate of potash (plats 1, 2, 3), and others (plats 4, 5, 6) in the form of the highest grade of potassium sulphate (95 per cent.). The subsequent tabular statement shows the quantities of manurial substances applied to the different plats: —

Plats.	Annual Supply of Manurial Substances.	Pounds.
Plat 1,	Sulphate of ammonia,	38
	Muriate of potash,	30
	Dissolved bone-black,	40
Plat 2,	Nitrate of soda,	47
	Muriate of potash,	30
	Dissolved bone-black,	40
Plat 3,	Dried blood,	75
	Muriate of potash,	30
	Dissolved bone-black,	40
Plat 4,	Sulphate of ammonia,	38
	Sulphate of potash,	30
	Dissolved bone-black,	40
Plat 5,	Nitrate of soda,	47
	Sulphate of potash,	30
	Dissolved bone-black,	40
Plat 6,	Dried blood,	75
	Sulphate of potash,	30
	Dissolved bone-black,	40

This proportion corresponds per acre to: —

	Pounds.
Phosphoric acid (available),	50.4
Nitrogen,	60.0
Potassium oxide,	120.0

A computation of the results of a chemical analysis of twenty prominent garden crops shows the following average relative proportion of the three above-stated ingredients of plant food: —

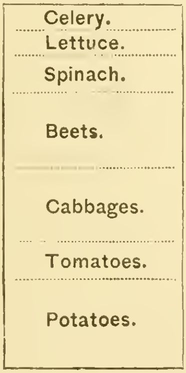
	Per Cent.
Nitrogen,	2.2
Potassium oxide,	2.0
Phosphoric acid,	1.0

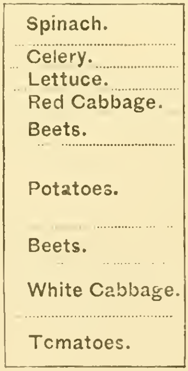
One thousand pounds of green garden vegetables contain, on the above-stated basis of relative proportion of essential constituents of plant food: —

	Pounds.
Nitrogen,	4.1
Potassium oxide,	3.9
Phosphoric acid,	1.9

The weights and particular stage of growth of the vegetables when harvested control, under otherwise corresponding conditions, the actual consumption of each of these articles of plant food. Our information regarding these points is still too fragmentary to enable a more detailed statement here beyond relative proportions. It must suffice for the present to call attention to the fact that a liberal manuring within reasonable limits pays, as a rule, better than a scanty one, especially in the case of those crops which reach in a short period the desired state of maturity. The various mixtures of fertilizers used by me in the experiments under discussion provide by actual supply for one-half of the available nitrogen actually called for to meet the demand as above pointed out. A liberal cultivation of peas and beans cannot fail to benefit the nitrogen resources of the soil. The order of arrangement of the different crops within each plat was the same in all of them for the same year. They occupied, however, a different position relative to each other in successive years, to introduce, as far as practicable, a system of rotation of crops.

Order of arrangement of crops in plats: —


Celery.
Lettuce.
Spinach.
Beets.
Cabbages.
Tomatoes.
Potatoes.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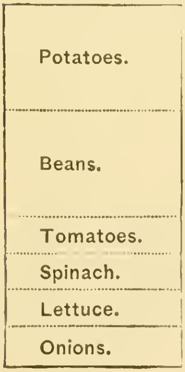
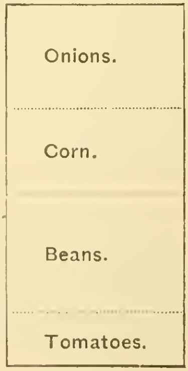
Celery.
Lettuce.
Red Cabbage.
Beets.
Potatoes.
Beets.
White Cabbage.
Tomatoes.


Potatoes.
Beans.
Tomatoes.
Spinach.
Lettuce.
Onions.


Onions.
Corn.
Beans.
Tomatoes.

The results of the stated three years were summed up as follows in my annual report for 1894, to which I have to refer for details. From our observations extending over three years we arrived at the following conclusions: —

Potash in the form of sulphate has given the most satisfactory results, as compared with muriate, in the case of potatoes, tomatoes, lettuce and spinach, and with onions during the present season.

Nitrogen in the form of nitrate of soda has given us, without regard to the potash source, the most satisfactory returns in case of spinach, lettuce, potatoes and tomatoes, and onions during the present season.

1895. — During the last season my observations have been confined to the cultivation of

Onions (Danvers Yellow).
Sweet Corn (Crosby Early).
Beans (Bush Horticultural).
Tomatoes (Essex Hybrid).

The different plats were ploughed April 20, and the particular fertilizer applied broadcast April 25. The soil was subsequently carefully prepared by harrowing, etc., for seeding and planting. The tomato plants were raised under glass and transplanted into the field when of a suitable size, May 25. The remaining crops were seeded directly in the field, — the onions May 1, the corn and the beans May 11.

The former division of the field into six plats, each containing the same crop for trial, — onions, beans, sweet corn and tomatoes, — was continued; each plat received the same mixture of fertilizing ingredients, and in the same proportion, as in the preceding years: —

	Pounds.
Available phosphoric acid, ...	50
Available nitrogen, ...	60
Available potassium oxide, ...	120

As each of the six plats measured 89½ by 62 feet, covering thus an area of 5,549 square feet, or about 100 square feet more than one-eighth of one acre, the following amount of each of the above-stated essential constituents of plant food was added to each of them: —

	Pounds.
Phosphoric acid,	7½
Potassium oxide,	15
Nitrogen,	6¼

The crops were planted across each plat, from north to south, in rows 62 feet in length; a corresponding number of rows of each crop was planted in each plat, and they were arranged in each case in the same order of succession, beginning on the west end: —

Onions (Danvers Yellow), eight rows.
Sweet corn (Crosby Early), four rows.
Beans (Bush Horticultural), nine rows.
Tomatoes (Essex Hybrid), two rows.

Onions.

The onions were sown in rows 14 inches apart May 1; they came up May 12. The young plants looked least satisfactory upon plats 1 and 4, and most promising upon plats 2 and 5, July 11. The crop was harvested on all plats October 5. Plats 2 and 5 yielded more than one-half of the entire marketable crop, while plats 1 and 5 yielded but one-fifteenth of it.

Yield of Onions (Pounds).

PLATS.	Marketable.	Small.	Scullions.	Total.
Plat 1,	None.	30	100	130
Plat 2,	630	165	10	805
Plat 3,	375	70	80	525
Plat 4,	125	180	65	370
Plat 5,	455	190	16	661
Plat 6,	390	52	90	532

Sweet Corn.

The corn was planted in rows 3 feet 3 inches apart, with 20 inches in the row, averaging 131 hills in each plat, May 11. The young plants came up May 27 quite uniformly on all plats.

July 11 the crop on Plat 1 looked lighter than on any of the rest. The canes were reduced to three in each hill before heading, and the tops removed after the ears were fully developed, to hasten on maturing of the crop. There is a marked difference in the results as far as Plat 1 is concerned, — organic nitrogen gives the highest results ; in case of different forms of potash, Plat 3 and Plat 6.

Yield of Sweet Corn when husked (Pounds).

PLATS.	Ears.	Husks.	Stover with Tops.	Total Weight.
Plat 1, ...	98	10	95	203
Plat 2.	117	8	115	240
Plat 3, ...	125	11	137	273
Plat 4, ...	112	10	125	247
Plat 5, ...	103	8	112	223
Plat 6, ...	118	10	130	258

Moisture in ears 34 per cent., in stover 20 per cent., when weighed.

Beans.

The beans were planted in rows 3 feet 3 inches apart May 11. They came up May 29 and blossomed July 6. At that time the crop looked best on Plat 5. The beans were harvested on all plats August 13, stacked on poles for drying, and were threshed in October.

Yield of Beans (Pounds).

PLATS.	Beans.	Pods and Vines.	Total Weight.
Plat 1, ...	81	260	341
Plat 2, ...	105	200	305
Plat 3, ...	83	155	238
Plat 4, ...	115	210	325
Plat 5, ...	135	260	395
Plat 6, ...	95	175	270

Tomatoes (Essex Hybrid).

The tomato plants were started under glass and transplanted in the field when from seven to eight inches high, May 25. They were of a vigorous growth, and were placed four feet apart each way. Each plat was planted with two rows, each row containing twenty-one plants. They began blooming June 5, and looked healthy at that time in all plats, yet best in Plat 5. The yield of matured tomatoes in case of plats 4 and 5 exceeded that of plats 3 and 6 by fully one-third in weight. The total yield of the crop, on account of more favorable weather of the past season, as compared with that of 1894, exceeded the latter by more than one-half of its weight.

Yield of Tomatoes (Pounds).

[Forty-two plants in each plat.]

DATE OF PICKING.	Plat 1.	Plat 2.	Plat 3.	Plat 4.	Plat 5.	Plat 6.	Total.
August 13,	10	11	12	18	5	19	75
August 16,	85	79	125	87	57	134	567
August 20,	100	109	101	136	115	116	677
August 23,	115	134	90	150	143	86	718
August 28,	50	122	77	102	116	110	577
September 3,	151	153	133	215	210	124	986
September 11,	70	80	40	127	164	43	524
September 20,	138	40	–	63	96	–	337
September 25,	28	93	–	33	90	–	244

Yield of Green Tomatoes left October 1 (Pounds).

Plat 1,	30
Plat 2,	52
Plat 3,	26
Plat 4,	54
Plat 5,	48
Plat 6,	24
Total,	234

Summary of Yield of Garden Crops raised under Corresponding Conditions from 1891 to 1896.

Spinach (Variety New Zealand).

[Pounds.]

PLATS.	1892.	1893.	1894.	Total.	Average per Year.
Plat 1 (two rows, 62 feet long), .	192	167½	101	460	153.3
Plat 2 (two rows, 62 feet long), .	233	182	216	631	210.5
Plat 3 (two rows, 62 feet long), .	202	180½	165	547	182.3
Plat 4 (two rows, 62 feet long), .	230	196	161¾	587	195.7
Plat 5 (two rows, 62 feet long), .	232	210	253	695	231.7
Plat 6 (two rows, 62 feet long), .	134	198½	113¾	446	148.7

Lettuce (Variety Hanson).

[Pounds.]

PLATS.	1892.	1893.	1894.	Total.	Average per Year.
Plat 1 (one row, 70 plants), .	41½	40½	29	111	37.0
Plat 2 (one row, 70 plants), .	36	42	52	130	43.3
Plat 3 (one row, 70 plants), .	43	46	36	125	41.7
Plat 4 (one row, 70 plants), .	76	62	50	188	62.7
Plat 5 (one row, 70 plants), .	60	70	68	198	66.0
Plat 6 (one row, 70 plants), .	36	55	33	124	41.3

Tomatoes (Variety Essex Hybrid).

[Pounds.]

PLATS.	1892.	1893.	1894.	1895.	Total.	Average per Year.
Plat 1 (two rows, 42 plants),	464	363	352	747	1,926	481.5
Plat 2 (two rows, 42 plants),	572	874½	559	821	2,826	706.5
Plat 3 (two rows, 42 plants),	466	807	458	578	2,309	577.3
Plat 4 (two rows, 42 plants),	515	818	604	931	2,868	717.0
Plat 5 (two rows, 42 plants),	593	978½	594	996	3,161	790.2
Plat 6 (two rows, 42 plants),	332	515	571	632	2,050	502.5

Beans (Bush Horticultural).

[Pounds.]

PLATS.	1894.	1895.	Total.	Average per Year.
Plat 1 (six rows), ...	45	54.0	99.0	49.5
Plat 2 (six rows), ...	32	70.0	102.0	50.1
Plat 3 (six rows), ...	41	55.5	96.5	48.2
Plat 4 (six rows), ...	20	67.7	87.7	43.8
Plat 5 (six rows), ...	37	90.0	127.0	63.5
Plat 6 (six rows), ...	49	63.3	112.3	56.1

Onions (Danvers Yellow Globe).

[Pounds.]

PLATS.	1894.	1895.	Total.	Average per Year.
Plat 1 (four rows), . . .	156	65.0	221.0	110.5
Plat 2 (four rows), . . .	249	402.5	651.5	325.7
Plat 3 (four rows), . . .	251	262.5	513.5	256.7
Plat 4 (four rows), . . .	256	185.0	441.0	220.5
Plat 5 (four rows), . . .	266	330.5	596.5	298.3
Plat 6 (four rows), . . .	204	265.5	469.5	234.8

Conclusions.

1. Sulphate of potash in connection with nitrate of soda (Plat 5) has given in every case but one (onions) the best results.

2. Nitrate of soda as nitrogen source (plats 2 and 5) has yielded in every case, without reference to the form of potash, the best returns.

3. Sulphate of ammonia as nitrogen source, in connection with muriate of potash as potash source (Plat 1), has given as a rule the least satisfactory returns.

4. The influence of the difference in the general character of the weather, whether normal or dry, during succeeding seasons on the yield of the crops has been greater than that of the different fertilizers used upon different plats during the same season.

5. FIELD EXPERIMENTS TO STUDY THE EFFECT OF PHOSPHATIC SLAG AND NITRATE OF SODA, AS COMPARED WITH GROUND BONE, ON THE YIELD OF OATS AND CORN.

The field used for this experiment is situated along a gently sloping ground, in the south-east corner of the farm. The soil consists of a sandy loam, and has been for several years under a careful system of cultivation and manuring. The productiveness was considered of uniform character when the experiment was planned in 1893. The area engaged in the observation was divided into two plats running along the slope from north to south. One plat, situated along the east side of the field, measured one acre (Plat 1); Plat 2 was situated along the west side of the field and measured one and nine-tenth acres.

Plat 1 was fertilized with 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre; Plat 2 was fertilized with 800 pounds of fine-ground phosphatic slag (odorless phosphate), 200 pounds of muriate of potash and 200 pounds of nitrate of soda per acre.

The amounts of manurial ingredients used per acre correspond to (in pounds): —

	Plat 1 (Bone).	Plat 2 (Phosphatic Slag).
Potassium oxide,	104	104
Phosphoric acid,	131	166
Nitrogen,	24	31

Composition of Fertilizer applied (Per Cent.).

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.
Ground bone,	4.09	21.86	–
Phosphatic slag,	–	20.84	–
Muriate of potash,	–	–	52.20
Nitrate of soda,	15.70	–	–

Cost of Fertilizer (1894).

Plat 1, bone and muriate of potash (per acre), $12.40.
Plat 2, phosphatic slag, muriate of potash and nitrate of soda (per acre), $15.70.

1894. — As the east side of the field was on a higher level than the west side, it was decided to run the crop across the two plats from east to west, to secure as far as practicable corresponding conditions of the layout of the area occupied by the crops. The northern half of the field thus divided (plats 1 and 2) measured one acre, the southern half one and nine-tenths acres.

Oats and corn (variety Pride of the North) were selected for our observations. The oats were sown broadcast, at the rate of 4 bushels per acre, upon the northern portion of the field, and the corn was planted in rows 3 feet 3 inches apart, with hills 20 inches from each other, upon the southern portion, using 12 quarts of seed corn per acre. The area occupied by oats amounted to .35 of an acre of Plat 1 and .65 of an acre of Plat 2; while the corn occupied .7 of an acre of Plat 1 and 1.2 acres of Plat 2.

Summary of Yield (1894).

[Pounds per Acre.]

	Plat 1 (Bone, etc.).	Plat 2 (Odorless Phosphate, etc.).
Oats, grain,	531	876
Oats, straw,	1,640	2,385
Corn, for ensilage,	16,294	20,608

To test the reliability of the results obtained, it was decided to repeat the experiments above described upon the same field. The fertilizers were used in the same proportion and in the same quantity per acre; they were applied upon the same portion of the field which had received each kind before. Oats and corn were again selected as crops for the trial. The material change in the experiment consisted in reversing the location of the crops; the corn was planted at the north end of the field, where the oats had been raised during the preceding season, and the oats were raised at the south end of the field, the part previously occupied by the corn. The oats were cut for hay when well headed out, and the corn when fully matured, for grain and stover.

Summary of Yield (1895).

[Pounds per Acre.]

	Bone and Muriate of Potash.	Phosphatic Slag, Nitrate of Soda, Muriate of Potash.
Oats, hay,	3,580	5,134
Corn, ears,*	3,410	4,231
Corn, stover,†	2,900	3,091

* Moisture, 28 per cent. † Moisture, 19.1 per cent. when harvested.

Conclusions.

The difference in the yield of oats and corn for two succeeding seasons points in the same direction; namely, phosphatic slag used in connection with nitrate of soda is a very efficient substitute for ground bone. To what extent these results, in our case, have to be ascribed to the presence of an excess of lime in the phosphatic slag, as compared with ground bone, is to be determined by a future actual trial.

6. EXPERIMENTS WITH A ROTATION OF MANURES UPON PERMANENT GRASS LANDS, MEADOWS AND PASTURES.

One of the many advantages derived from the introduction of commercial fertilizers and chemicals for manurial purposes into general farm practice consists in the circumstance that in many instances a change with reference to the general character of the manure applied has served efficaciously as a substitute for a change of crops. The improved chances in compounding the manures to suit special requirements of soil and crops have, to say the least, greatly modified current views regarding the desirability or necessity of a rotation of crops in the interest of economy. The beneficial results noticed in other connections, due to a change in the general character of the manurial substances used, in case of the same land and in connection with the same crops, caused the arrangement of the experiments described upon a few subsequent pages.

Permanent grass lands are apt to suffer in the course of time from an accumulation of half-decayed vegetable matter, which is liable sooner or later to interfere with a healthy growth. To counteract this tendency it was decided to manure meadows alternately by top-dressing with barn-yard manure, or bone and muriate of potash, or wood ashes. The liberal amount of carbonate of lime, from 30 to 40 per cent., contained in the current supply of unleached wood ashes, was to serve as the means to hasten on the decomposition of the accumulating vegetable matter, and thereby secure favorable conditions for a healthy growth of valuable forage plants.

The meadows under consideration comprise an area of about 9.6 acres. The entire field up to 1886 consisted of old, worn-out grass lands, overrun with a worthless growth on its more elevated portion and covered with weeds and sedges in its lower swampy portion. The improvement of the land by underdraining was commenced in 1886 and continued during the succeeding year. For details of the work, see ninth and tenth annual reports (1891–92).

In the spring of 1893 a change was made in the mode of manuring of the grass plats. It was decided to study the effect of a rotation of the three kinds of manures : barn-yard manure, bone and muriate of potash and Canada wood ashes, which had been applied for several years previous in succession and upon the same portion of the fields. The area was divided into three plats, Plat 1 (3.97 acres), Plat 2 (2.59 acres) and Plat 3 (3 acres). The system of manuring adopted was as follows : —

Plat 1, wood ashes, 1 ton per acre.

Plat 2, barn-yard manure, 8 tons per acre.

Plat 3, fine-ground bone 600 pounds, and muriate of potash 200 pounds, per acre.

The barn-yard manure was applied broadcast late in autumn, the others early in the spring.

1895. — The above arrangement of plats was continued during that season, and fertilizers were applied in the same proportion to the same plats.

Summary of Yield of Hay (*Tons*).

	RATE PER ACRE (TONS).		
	First Cut.	Second Cut, "Rowen."	Total.
1893.			
Plat 1, wood ashes, 1 ton per acre,	2.28	.77	3.05
Plat 2, barn-yard manure, 8 tons per acre,	2.62	.86	3.48
Plat 3, 600 pounds ground bone and 200 pounds muriate of potash per acre,	1.94	.64	2.58
1894.			
Plat 1, wood ashes, 1 ton per acre,	2.50	.37	2.87
Plat 2, barn-yard manure, 8 tons per acre,	2.86	.51	3.37
Plat 3, 600 pounds ground bone and 200 pounds muriate of potash per acre,	2.54	.18	2.72
1895.			
Plat 1, 600 pounds ground bone and 200 pounds muriate of potash per acre,	2.18	1.60	3.14
Plat 2, wood ashes, 1 ton per acre,	2.17	1.44	3.12
Plat 3, barn-yard manure, 8 tons per acre,	3.02	1.04	3.13

The season of 1894 was marked by a severe drought, beginning with the month of July and extending into the fall, which affected the yield of the crop (second cut) to a serious extent. The season of 1895 was a fair one for farm work in our section of the country.

PART II.

REPORT ON THE WORK IN THE CHEMICAL LABORATORY.

CHARLES A. GOESSMANN.

1. ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS IN 1895.

During the past year fifty-five manufacturers and dealers in commercial fertilizers and agricultural chemicals have applied for and secured licenses for the sale of their goods in the State; twenty-seven of them being residents of Massachusetts, and the remainder belonging to Vermont, Rhode Island, Connecticut, New York, New Jersey, Maryland, Pennsylvania, Illinois, Ohio and Canada.

The number of different brands collected in the general market amounted to two hundred and ninety. The sampling and collecting of the material for analysis were in charge of Mr. H. D. Haskins, an efficient assistant in the chemical laboratory of the division of chemistry of the station, who for several years past has attended to that part of the inspection in a very satisfactory manner. Two hundred and seventy samples of the various brands collected by him were carefully analyzed, and the results obtained in that direction have been published and distributed in five special bulletins, *i. e.*, No. 57 old series and Nos. 30, 31, 32 and 34 of the Hatch station series.

The results of the inspection have been on the whole quite satisfactory, as far as the compliance of the dealers with the provision of our State laws for the regulation of the trade in commercial fertilizers is concerned. The variations here and there noticed between the guaranteed composition of the dealer and the results of our analyses could be traced with but few exceptions to imperfect mixing of the several ingredients of the fertilizer, and did not, as a rule, materially affect the commercial value of the article. In this connection attention should be called to the fact that the lowest amount stated in the guarantee is only legally binding. As our State law makes allowance for these circumstances, the results of our examinations have been published without further comment. When deemed best for the interest of all parties concerned, the results have been sent by letter to the manufacturers of the goods, for their guidance and consideration. To convey a more direct idea of the actual value of this feature in the trade of commercial fertilizers of 1895, the following detailed statement is here inserted : —

(*a*) Where three essential elements of plant food were guaranteed : —

Number with three elements equal to or above the highest guarantee,	5
Number with two elements above the highest guarantee,	11
Number with one element above the highest guarantee,	49
Number with three elements between the lowest and highest guarantees,	45
Number with two elements between the lowest and highest guarantees,	54
Number with one element between the lowest and highest guarantees,	27
Number with two elements below the lowest guarantee,	6
Number with one element below the lowest guarantee,	30

(*b*) Where two essential elements of plant food were guaranteed : —

Number with two elements above the highest guarantee,	1
Number with one element above the highest guarantee,	11
Number with two elements between the lowest and highest guarantees,	17
Number with one element between the lowest and highest guarantees,	7
Number with one element below the lowest guarantee,	10

(*c*) Where one essential element of plant food was guaranteed : —

Number above the highest guarantee,	4
Number between the lowest and highest guarantees,	21
Number below the lowest guarantee,	6

The consumption of commercial fertilizers is steadily increasing, a circumstance apparently not less due to a more general recognition of their good services, if judiciously selected and applied, than to gradual improvements in regard to their mechanical condition as well as their general chemical character. A noticeable change regarding the chemical composition of many brands of so-called complete or formula fertilizers of to-day, as compared with those offered for similar purposes at an earlier period in the history of the trade in commercial fertilizers, consists in a more general and more liberal use of potash compounds as a prominent constituent. This change has been slow but decided, and may in a large degree be ascribed to the daily increasing evidence, resting on actual observations in the field and garden, that the farm lands of Massachusetts are quite frequently especially deficient in potash compounds, and consequently need in many instances a more liberal supply of available potash from outside sources to give satisfactory returns. Whenever the cultivation of garden vegetables, fruits and forage crops constitutes the principal products of the land, this recent change in the mode of manuring deserves in particular a serious trial; for the crops raised consume exceptionally large quantities of potash, as compared with grain crops. In view of these facts, it will be conceded that a system of manuring farm and garden, which tends to meet more satisfactory recognized conditions of large areas of land as well as the special wants of important growing branches of agricultural industries, is a movement in the right direction. A judicious management of the trade in commercial fertilizers implies a due recognition of well-established experimental results regarding the requirements of a remunerative production of farm and garden crops.

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in This State during the Past Year (May 1, 1895, to May 1, 1896), and the Brands licensed by Each.

Armour & Co., Chicago, Ill.: —
- Bone Meal.
- Bone and Blood.
- All Soluble.
- Bone, Blood and Potash.

H. J. Baker & Bro., New York, N. Y.: —
- Standard Unexcelled Fertilizer.
- Strawberry Manure.
- Complete Onion Manure.
- Complete Potato Manure.
- Complete Tobacco Manure.
- Complete Grass and Lawn Manure.
- Complete Corn Manure.
- A A Ammoniated Superphosphate.
- Strictly Pure Ground Bone.
- Vegetable and Vine Fertilizer.

C. A. Bartlett, Worcester, Mass.: —
- Complete Animal Fertilizer.
- Pure Ground Bone.

Bowker Fertilizer Company, Boston, Mass.: —
- Stockbridge Special Manures.
- Bowker's Hill and Drill Phosphate.
- Bowker's Farm and Garden Phosphate.
- Bowker's Lawn and Garden Dressing.
- Bowker's Fish and Potash.
- Bowker's Potato and Vegetable Manure.
- Bowker's Market-garden Manure.
- Bowker's Sure Crop Bone Phosphate.
- Bowker's Gloucester Fish and Potash.
- Bowker's Dry Ground Fish.
- Bowker's Fresh Ground Bone.
- Nitrate of Soda.
- Dried Blood.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulphate of Potash.
- Sulphate of Ammonia.

Bradley Fertilizer Company, Boston, Mass.: —
- Bradley's X L Superphosphate.
- Bradley's Potato Manure.
- Bradley's B D Sea-fowl Guano.
- Bradley's Complete Manures.
- Bradley's Fish and Potash.
- Bradley's High-grade Tobacco Manure.
- Bradley's English Lawn Dressing.
- Farmers' New-method Fertilizer.
- Breck's Lawn and Garden Dressing.
- Eclipse Phosphate.
- Dry Ground Fish.
- High-grade Sulphate of Potash.
- Low-grade Sulphate of Potash.
- Muriate of Potash.
- Nitrate of Soda.
- Sulphate of Ammonia.
- Dissolved Bone-black.
- Fine-ground Bone.

Wm. J. Brightman & Co., Tiverton, R. I.: —
- High-grade Potato and Root Manure.
- Brightman's Phosphate.
- Brightman's Fish and Potash.

Bryant, Brett & Simpson, New Bedford, Mass.: —
- Ground Bone.

B. L. Bragg & Co., Springfield, Mass.: —
- Hampden Lawn Dressing.

Dan. T. Church, Providence, R. I.: —
- Church's B Special Fertilizer.
- Church's D Fish and Potash.
- Church's C Standard.

Clark's Cove Fertilizer Company, Boston, Mass.: —
- Bay State Fertilizer.
- Bay State Potato Manure.
- Great Planet Manure.
- Fish and Potash.
- King Philip Guano.
- White Oak Pure Ground Bone.

Clark's Cove Fertilizer Company, Boston, Mass. — *Concluded.*
Bay State Fertilizer, G G Brand.
Potato and Tobacco Fertilizer.
Tobacco Fertilizer.
Blood, Bone and Meat.
Dissolved Bone-black.
Double Manure Salts.
Sulphate of Potash.
Muriate of Potash.
Nitrate of Soda.

Cleveland Dryer Company, Boston, Mass. : —
Cleveland Superphosphate.
Potato Phosphate.
Corn and Grain Phosphate.
Fertilizer.
High-grade Complete Manure.

E. Frank Coe Company, New York, N. Y. : —
Gold Brand Excelsior Guano.
High-grade Ammoniated Bone Superphosphate.
Special Potato Fertilizer.
Fish and Potash.
High-grade Potato Fertilizer.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y. : —
Special Potato Fertilizer.
Ammoniated Bone Superphosphate.
Ammoniated Wheat and Corn Phosphate.
New Rival Ammoniated Superphosphate.
Potato Hop and Tobacco Phosphate.
Ground Bone Meal.
Practical Ammoniated Superphosphate.
Pure Ground Bone.
Vegetable Bone Superphosphate.

Cumberland Bone Phosphate Company, Boston, Mass. : —
Superphosphate.
Potato Fertilizer.
Fertilizer.
Concentrated Phosphate.
Fine-ground Bone.

L. B. Darling Fertilizer Company, Pawtucket, R. I. : —
Animal Fertilizer.
Extra Bone Phosphate.
Potato and Root Fertilizer.
Lawn and Garden Manure.
Tobacco Grower.
Pure Fine Bone.
Pure Dissolved Bone.
High-grade Sulphate of Potash.

John C. Dow & Co., Boston, Mass. : —
Dow's Ground Bone Fertilizer.
Dow's Nitrogenous Superphosphate.
Dow's Pure Ground Bone.

Eastern Farm Supply Association, Montclair, N. J. : —
Carteret Farm Manure.
Carteret Potato Manure.
Carteret Corn and Grain Manure.
Carteret Market-garden Manure.

Forest City Wood Ash Company, Boston, Mass. : —
Unleached Hard-wood Ashes.
Odorless Mineral Guano.

Wm. E. Fyfe & Co., Clinton, Mass. : —
Canada Ashes.

Great Eastern Fertilizer Company, Rutland, Vt. : —
Great Eastern Soluble Bone and Potash.
Great Eastern Grain and Grass.
Great Eastern Oats, Buckwheat and Seeding-down.
Great Eastern Vegetable Vine and Tobacco.

Edmund Hersey, Hingham, Mass. : —
Ground Bone.

John G. Jefferds, Worcester, Mass. : —
Animal Fertilizer.
Potato Fertilizer.
Ground Bone.

A. Lee & Co., Lawrence, Mass. : —
Lawrence Fertilizer.

Lowe Bros. & Co., Fitchburg, Mass. : —
Tankage.

Lowell Rendering Company, Chelmsford, Mass. : —
Lowell Bone Fertilizer.

The Mapes Formula and Peruvian Guano Company, New York, N. Y. : —
Mapes' Bone Manures.
Mapes' Superphosphates.
Mapes' Special Crop Manures.
Mapes' Peruvian Guano.
Mapes' Economical Manure.
Sulphate of Potash.
Double Manure Salts.
Nitrate of Soda.

Mason, Chapin & Co., Providence, R. I. : —
Chemical Compound Corn Fertilizer.
Chemical Compound Lawn Fertilizer.
Chemical Compound Vegetable Fertilizer.
Chemical Compound Tobacco Fertilizer.
Lawn and Grass Fertilizer.

McQuade Bros., Worcester, Mass. : —
Pure Ground Bone.

Monroe, Lalor & Co., Oswego, N. Y. : —
Canada Unleached Hard-wood Ashes.

Robert L. Merwin & Co., New York, N. Y. : —
Albert's Highly Concentrated Horticultural Manure.

National Fertilizer Company, Bridgeport, Conn. : —
Ammoniated Bone Phosphate.
Chittenden's Complete Fertilizer.
Fish and Potash.
Ground Bone.

New England Dressed Meat and Wool Company, Boston, Mass. : —
Sheep Fertilizer.

Niagara Fertilizer Company, Buffalo, N. Y. : —
Niagara Triumph.
Niagara Grain and Grass Grower.
Niagara Wheat and Corn Producer.
Niagara Potato, Tobacco and Hop Fertilizer.

Pacific Guano Company, Boston, Mass. : —
- Soluble Pacific Guano.
- Special Potato Fertilizer.
- Special for Potatoes and Tobacco.
- High-grade General Fertilizer.
- Fish and Potash.
- Muriate of Potash.
- Dissolved Bone-black.
- Nitrate of Soda.
- Sulphate of Potash.

John J. Peters & Co., Long Island City, N. Y. : —
- Sheep Fertilizer.

Parmenter & Polsey Fertilizer Company, Peabody, Mass. : —
- Plymouth Rock Brand.
- Special Potato Fertilizer.
- Star Brand Superphosphate.
- Ground Bone.
- Muriate of Potash.
- Nitrate of Soda.

Prentiss Brooks & Co., Holyoke, Mass. : —
- Complete Manures.
- Phosphate.
- Nitrate of Soda.
- Tankage.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulphate of Potash.
- Fish and Potash.
- Fish.

Quinnipiac Company, Boston, Mass. : —
- Phosphate.
- Potato Manure.
- Onion Manure.
- Havana Tobacco Fertilizer.
- Corn Fertilizer.
- Market-garden Manure.
- Potato and Tobacco Manure.
- Fish and Potash, " Crossed Fishes."
- Fish and Potash, " Plain Brand."
- Grass Fertilizer.

Quinnipiac Company, Boston, Mass. — *Concluded.*
- Pure Bone Meal.
- Dry Ground Fish.
- Strawberry Manure.
- Ammoniated Dissolved Bones.
- Nitrate of Soda.
- Sulphate of Potash.
- Muriate of Potash.
- Double Manure Salts.

Read Fertilizer Company, New York, N. Y.: —
- Read's Standard.
- High-grade Farmers' Friend.
- Fish and Potash.
- Vegetable and Vine.

N. Roy & Son, South Attleborough, Mass.: —
- Animal Fertilizer.

The Rogers & Hubbard Company, Middletown, Conn.: —
- Pure Ground Raw Knuckle Bone Meal.
- Strictly Pure Fine Bone.
- Fertilizer for Oats and Top-dressing.
- Soluble Potato Manure.
- Fairchild's Formula for Corn and General Crops.
- Soluble Tobacco Manure.
- Grass and Grain Fertilizer.

Russia Cement Company, Gloucester, Mass.: —
- Essex Complete Manure for Potatoes and Roots.
- Essex Complete Manure for Corn and Grain.
- Essex Perfected Lawn Dressing.
- Essex Special Vegetable Manure.
- Essex High-grade Fish and Potash.

Lucien Sanderson, New Haven, Conn.: —
- Formula "A."
- Bone, Meat and Blood.
- Dissolved Bone-black.
- Sulphate of Potash.
- Muriate of Potash.
- Nitrate of Soda.

Edward H. Smith, Northborough, Mass.: —
- Ground Bone.

Springfield Provision Company, Brightwood, Mass. : —
Blood, Meat and Bone.

Standard Fertilizer Company, Boston, Mass. : —
Complete Manure.
Potato and Tobacco Manure.
Fertilizer.
Guano.
Fish and Potash.
Fine-ground Bone.
Muriate of Potash.
Dissolved Bone-black.

T. L. Stetson, Randolph, Mass. : —
Pure Ground Bone.

F. C. Sturtevant, Hartford, Conn. : —
Ground Tobacco Stems.

Charles Stevens, Napanae, Ontario, Can. : —
Unleached Hard-wood Ashes.

Henry F. Tucker, Boston, Mass. : —
Tucker's Original Bay State Bone Superphosphate.
Tucker's Imperial Bone Superphosphate.
Tucker's Special Potato Fertilizer.

Thompson & Edwards Fertilizer Company, Chicago, Ill. : —
Pure Fine-ground Bone.

Walker, Stratman & Co., Pittsburg, Pa. : —
Potato Special.
Smoky City.
Big Bonanza.
Four Fold.

M. E. Wheeler & Co., Rutland, Vt. : —
High-grade Fruit Fertilizer.
Grass and Oats Fertilizer.
Electrical Dissolved Bone.
Potato Manure.
High-grade Corn Fertilizer.

Leander Wilcox, Mystic, Conn.: —
- Potato, Onion and Tobacco Manure.
- Ammoniated Bone Phosphate.
- Fish and Potash.
- Dry Ground Fish.

Williams & Clark Fertilizer Company, Boston, Mass.: —
- Americus Ammoniated Bone Superphosphate.
- Potato Phosphate.
- Grass Manure.
- Pure Bone Meal.
- High-grade Special.
- Corn Phosphate.
- Fine Wrapper Tobacco Fertilizer.
- Universal Ammoniated Dissolved Bone.
- Fish and Potash.
- Dry Ground Fish.
- Potato and Tobacco Manure.
- Royal Bone Phosphate.
- Onion Manure.
- Dissolved Bone-black.
- Nitrate of Soda.
- Double Manure Salts.
- Sulphate of Potash.
- Muriate of Potash.

2. GENERAL WORK IN THE LABORATORY OF THE DIVISION OF CHEMISTRY.

The work in the chemical laboratory of the united stations has been divided by a recent vote of the board of trustees between the newly created division of "Foods and Feeding" and the "Division of Chemistry." The separate operation of the two divisions dates from July 1, 1895. The analyses of feeds stuffs, dairy products and well waters made before that date are incorporated in the annual report of Dr. J. B. Lindsey, who by vote of the trustees has been placed in charge of the new division of foods and feeding, which includes in its scope the examination of these substances.

Aside from the supervision of the inspection of commercial fertilizers, the results of which are discussed in a few preceding pages, my attention has been divided between the direction of a series of experiments in the field and vegetation house, introduced some years ago for the purpose of studying the economy of various systems of manuring and raising field and garden crops, and an extensive correspondence with farmers and others, asking for information regarding a variety of subjects of interest to them. The description of the former constitutes the first part of this report. The results of the examination of many manurial substances sent on for that purpose in connection with the latter, whenever of general interest, have been published during the past year in the bulletins of the station. They are also recorded in connection with the tabular compilation of analyses of manurial substances which accompanies this report.

The constantly increasing variety of waste products of many branches of industry within our State and elsewhere which have proved of manurial value, has received for years a serious attention. Both producers and consumers have been materially benefited by this work, which aims to make known the particular fitness of each for manurial purposes, and thereby furnishes a basis for the determination of its commercial value. As a change in the current modes of manufacture of the parent industry is at any time liable to seriously affect the character and chemical composition of the waste or by-products, it becomes necessary to repeat from time to time analyses of many of these products. These analyses are made without any charge for the work, on the condition that the results are public property, if deemed of interest for publication.

As a brief enumeration of the more prominent substances sent on for our investigation during the year 1895 can best convey a correct idea concerning the extent and importance of the labor involved, the following statement is presented: the whole number of analyses made in the stated connection amounts for the year 1895 to one hundred and eighty-six; of these, from eighty to ninety consisted of ashes, including wood ashes, coal ashes, lime-kiln ashes, cotton-hull ashes, swill ashes, soots, etc.; from twenty to thirty were agricultural chemicals, comprising potash salts, Chili saltpetre, sulphate of ammonium, gypsum, kainites, dissolved bone-black, phosphatic slag, etc.; twenty-eight were animal refuse materials, as fish waste, tankage, blood, animal meal, meat scraps, blood and bone, bones, wool waste, sheep fertilizer, etc.; and from twenty to thirty consisted of vegetable refuse materials, as cotton-factory waste, cotton-seed meal, tobacco stems, madder, peats, vegetable compost, etc.

Of a special interest is the recent introduction of the products prepared from the kitchen refuse of our large cities. Sanitary considerations are indirectly the cause of the appearance of these products, which promise to become of considerable prominence in the future.

One mode disposes of the refuse by cremation. The product resulting is called cremation ashes, and contains a liberal amount of phosphate of lime and more or less potash. The nitrogen and organic matter are lost in the process of cremation. Grinding and proper mixing of the products cannot fail to furnish a valuable material for manurial purposes. The tabular statement below gives the results of analyses of swill or cremation ashes, mostly if not entirely from Lowell, Mass.

Another mode proposes to save the nitrogen and organic matter by a so-called reduction process. The parties interested in the matter propose to reduce the garbage with sulphuric acid, remove the fat, add to the refuse natural phosphates to combine with the excess of sulphuric acid, and add potash compounds if needed. This interesting process is apparently still in the experimental stage. A sample of the product sent here for examination gives the results found below. Modern views regarding the requirements of sanitary condition in our centres of population cannot fail to recognize the efficiency of both processes to dispose of objectionable material. The economical advantages derived from these modes of operation experience alone can determine. The product of either mode has its special claim for consideration. The agricultural interests of the country cannot fail to benefit by a successful development of either mode of operation.

Analyses of Ashes from a Crematory Furnace, Lowell, Mass.

	1.	2.	3.	4.	5.	6.	7.
Moisture at 100° C.,	0.51	0.07	0.04	0.11	2.43	19.46	12.48
Potassium oxide,	1.73	8.83	7.03	1.25	1.59	1.78	3.35
Phosphoric acid,	16.61	17.18	26.09	32.26	25.89	5.22	6.50
Calcium oxide,	24.79	28.18	33.74	47.60	-*	-*	-*
Ferric and aluminic oxides,	3.56	7.63	6.25	1.06	-*	-*	-*
Magnesium oxide,	1.87	-*	-*	-*	-*	-*	-*
Insoluble matter before calcination,	39.60	18.49	14.40	15.13	-*	-*	-*
Insoluble matter after calcination,	29.72	16.53	11.41	13.20	17.93	30.81	31.54

	8.	9.	10.	11.	12.	13.	14.
Moisture at 100° C.,	0.37	7.57	14.24	8.05	1.20	1.19	0.87
Potassium oxide,	4.27	3.96	5.09	4.92	5.71	4.83	4.08
Phosphoric acid,	12.97	13.92	6.86	13.22	10.82	10.21	71.47
Insoluble matter after calcination,	34.91	19.96	37.76	24.52	29.91	24.50	26.73

* Not determined.

Analysis of a Refuse Product obtained from City Garbage, sent on by the American Reduction Company, New York City.

	Per Cent.
Moisture at 100° C.,	8.52
Nitrogen,	1.64
Potassium oxide,	1.20
Sodium oxide,	2.50
Calcium oxide,	3.86
Magnesium oxide,	.55
Ferric and aluminic oxides,	7.64
Total phosphoric acid,	10.62
Available phosphoric acid,	8.08
Insoluble phosphoric acid,	2.54
Sulphuric acid,	8.54
Organic matter,	45.43
Insoluble matter (ash),	12.15

3. COMPILATION OF ANALYSES MADE AT AMHERST, MASS., OF AGRICULTURAL CHEMICALS AND REFUSE MATERIALS USED FOR FERTILIZING PURPOSES.

PREPARED BY H. D. HASKINS.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868 to 1896.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1896, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years.

C. A. G.

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
I. Chemicals, Refuse, Salts, Ashes, etc.																							
Muriate of potash,	79	1.80	-	-	-	-	58.98	45.94	51.02	-	-	-	-	-	-	6.69	-	.55	-	-	-	48.80	.70
Sulphate of potash,	32	2.12	-	-	-	-	51.30	21.36	38.67	-	-	-	-	-	-	4.46	-	1.50	-	45.72	-	-	.75
Sulphate of potash-magnesia,	26	4.85	-	-	-	-	29.48	16.96	24.82	-	-	-	-	-	-	6.25	2.57	-	-	44.25	-	2.60	1.41
Carbonate of potash,	1	26.88	-	-	-	-	-	-	18.48	-	-	-	-	-	-	-	-	19.52	-	-	-	-	.39
Phosphate of potash,	1	3.76	-	-	-	-	-	-	32.56	-	-	37.50	-	-	-	-	-	-	-	13.43	-	-	.92
Kainite,	5	3.18	-	-	-	-	16.48	12.51	13.56	-	-	-	-	-	-	18.97	1.15	9.80	-	20.25	-	33.25	2.13
Carnallite,	1	-	-	-	-	-	-	-	13.68	-	-	-	-	-	-	7.66	-	13.19	-	.56	-	41.56	-
Krugite,	1	4.82	-	-	-	-	-	-	8.42	-	-	-	-	-	-	5.27	12.45	8.79	-	31.94	-	6.63	14.96
Sulphate of magnesia (Kieserite),	9	22.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.30	-	36.10	-	-	5.73
Nitrate of potash,	4	1.30	-	14.58	11.60	12.71	45.62	44.76	45.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate of soda,	36	1.42	-	16.22	14.28	15.02	-	-	-	-	-	-	-	-	-	35.50	-	-	-	-	-	.50	.50
Sulphate of ammonia,	28	1.06	-	21.68	19.59	22.03	-	-	-	-	-	-	-	-	-	-	-	-	-	60.00	-	-	-
Phosphate of ammonia,	1	6.05	-	-	-	10.37	-	-	-	-	-	43.86	-	-	-	-	-	-	-	12.46	-	-	.82
Sulphate of soda,	1	1.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59.43	-	-	-
Saltpetre waste,	12	2.54	-	3.30	.52	2.22	30.94	1.55	13.66	-	-	-	-	-	-	37.04	.75	.19	-	1.85	-	46.25	-

Nitre salt-cake,	2	6.03	-	-	-	2.29	-	-	.87	-	-	-	-	-	-	29.56	-	-	-	47.77	-	-	3.92
Wood ashes,	476	10.64	-	-	-	-	10.80	1.20	5.37	5.58	.05	1.52	-	-	-	-	33.58	3.31	.96	-	-	-	14.22
Cotton-seed-hull ashes,	49	8.21	-	-	-	-	42.12	9.91	22.77	13.67	2.89	8.15	-	-	-	-	9.30	10.47	1.76	-	-	-	13.44
Ashes of spent tan-bark,	5	4.84	-	-	-	-	2.87	.60	1.81	2.77	.13	1.36	-	-	-	-	31.11	3.39	1.78	-	-	-	25.21
Corn-cob ashes,	1	1.20	-	-	-	-	-	-	7.08	-	-	2.37	-	-	-	-	11.70	-	1.28	-	-	-	52.09
Railroad-tie ashes,	1	4.70	-	-	-	-	-	-	.92	-	-	.56	-	-	-	-	2.51	-	-	-	-	-	80.20
Peat ashes,	1	4.67	-	-	-	-	-	-	.46	-	-	.11	-	-	-	-	2.28	1.63	6.13	-	-	-	45.17
Logwood ashes,	1	1.50	-	-	-	-	-	-	.08	-	-	2.30	-	-	-	-	3.90	-	-	-	-	-	9.70
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Ashes from cremation of swill,	14	4.89	-	-	-	-	8.83	1.25	4.17	32.36	7.47	14.66	-	-	-	-	33.58	1.87	4.65	-	-	-	19.73
Ashes from blue works,	1	12.14	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Gypse,	1	1.64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50.87	-	-	-	-	-	2.87
Nova Scotia plaster (gypsum),	15	8.63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32.85	.75	-	45.12	-	-	3.47
Onondaga plaster (New York gypsum),	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
Lime,	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	93.63	-	-	-	-	-	1.33
Waste lime,	1	.80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	74.12	-	-	-	-	-	.38
Gas house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime kiln ashes,	17	14.48	-	-	-	-	2.78	.02	1.28	3.16	.36	1.09	-	-	-	-	42.57	2.60	-	-	17.75	-	7.69
Bituminous coal ashes,	1	7.18	-	-	-	-	-	-	.60	-	-	.43	-	-	-	-	-	-	-	-	-	-	68.50

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
I. Chemicals, Refuse, Salts, Ashes, etc. —Concluded.																							
Marls (Massachusetts),	7	13.70	-	-	-	-	-	-	.24	2.72	.06	1.05	-	-	-	-	40.50	.64	.69	-	28.57	-	3.44
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	.49	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Green sand marl (Virginia),	1	1.25	-	-	-	-	-	-	1.14	-	-	9.37	-	-	-	-	25.78	-	5.13	-	-	-	41.32
Olive earth (Virginia),	1	1.97	-	-	-	-	-	-	.24	-	-	13.73	-	-	-	-	19.16	-	6.00	-	-	-	50.55
Ammoniated marl,	1	3.31	-	-	-	1.61	-	-	-	-	-	10.39	-	.41	9.98	-	-	-	-	-	-	-	-
Marl (North Carolina),	1	1.56	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18
Clay (so called),	1	.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54.35	1.04	2.80	-	37.32	-	2.57
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	7.85	4.08	1.14	2.61	20.60	5.96	15.26	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano from Texas,	9	40.09	18.24	10.51	2.58	6.47	-	-	1.31	6.53	1.00	3.76	-	-	-	-	-	-	-	-	-	-	2.00
Bat guano from Florida,	2	15.66	-	-	-	9.74	-	-	1.77	3.44	3.26	3.35	-	-	-	-	-	-	-	-	-	-	19.33
Rat guano from Florida,	1	10.32	-	-	-	3.32	-	-	6.85	-	-	2.30	-	-	-	-	-	-	-	-	-	-	1.15
Cuban guano,	5	24.27	-	2.74	.63	1.67	-	-	-	16.16	11.54	13.35	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (orchilla),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	26.77	-	-	-	-	39.95	3.29	-	2.68	-	-	1.27
Mona Island guano,	1	13.32	-	-	-	.76	-	-	-	-	-	21.88	-	7.55	14.33	-	37.49	-	-	-	-	-	2.45

South Carolina rock phosphate,	6	1.45	-	-	-	-	-	-	-	30.51	24.70	27.47	.27	.07	27.13	-	41.87	3.03	4.80	-	-	-	9.04
South Carolina floats,	1	.83	-	-	-	-	-	-	-	-	-	23.39	-	2.33	21.06	-	-	-	-	-	-	-	20.16
Florida rock phosphate,	29	2.09	-	-	-	-	-	-	-	38.97	6.95	26.15	-	-	-	-	30.40	-	7.56	-	-	-	27.29
Soft Florida phosphate,	3	4.87	-	-	-	-	-	-	-	19.94	17.71	18.73	-	-	-	-	23.72	-	6.82	-	-	-	20.92
Navassa phosphate,	2	7.60	-	-	-	-	-	-	-	34.45	34.09	34.27	-	-	-	-	37.45	-	10.27	-	-	-	2.70
Brockville phosphate,	1	2.50	-	-	-	-	-	-	-	-	-	35.21	-	-	-	-	-	-	-	-	-	-	6.46
Phosphatic slag,	4	1.45	-	-	-	-	-	-	-	30.51	18.91	23.49	-	3.06	21.65	-	48.66	3.42	10.12	-	-	-	9.40
Odorless phosphate,	6	2.99	-	-	-	-	.52	.04	.38	21.74	18.40	19.54	-	.52	19.82	-	51.42	-	-	-	2.51	-	9.14
Dissolved bone-black,	6	10.31	47.50	-	-	-	-	-	-	17.54	14.99	16.00	14.48	1.15	.37	-	-	-	-	-	-	-	3.99
Bone-black,	5	4.60	-	-	-	-	-	-	-	30.54	16.56	28.28	-	-	-	-	-	-	-	-	-	-	3.64
Double superphosphate,	1	5.74	-	-	-	-	-	-	-	-	-	47.80	38.38	9.04	.38	-	16.00	-	-	1.19	-	-	.60
South American bone-ash,	1	7.00	-	-	-	-	-	-	-	-	-	35.89	-	-	-	-	44.89	-	-	-	-	-	4.50
Acid phosphate,	1	14.23	69.95	-	-	-	-	-	-	-	-	14.64	10.34	2.42	1.88	-	-	-	-	-	-	-	10.81
III. Refuse Substances.																							
Dried blood,	17	11.97	6.37	13.55	8.10	10.48	-	-	-	6.23	1.30	2.00	-	-	-	-	-	-	-	-	-	-	-
Ammonite,	1	5.88	-	-	-	11.33	-	-	-	-	-	3.43	-	-	-	-	-	-	-	-	-	-	1.38
Oleomargarine refuse,	1	8.54	14.42	-	-	12.12	-	-	-	-	-	.88	-	-	-	-	-	-	-	-	-	-	.96
Felt refuse,	1	29.24	33.53	-	-	5.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sponge refuse,	1	7.25	-	-	-	2.43	-	-	-	-	-	3.19	-	-	-	-	3.94	1.27	-	-	-	-	39.05
Blood and bone,	2	8.36	-	6.80	6.68	6.74	-	-	-	11 39	10.62	11.01	-	2.82	7.80	-	-	-	-	-	-	-	-
Horn shavings,	1	4.83	-	-	-	15.31	-	-	-	-	-	.42	-	-	-	-	-	-	-	-	-	-	-

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
III. Refuse Substances — Continued.																							
Ivory dust,	1	11.50	52.63	-	-	6.64	-	-	-	-	-	24.56	.97	17.97	5.62	-	-	-	-	-	-	-	-
Horn and hoof waste,	3	10.17	7.63	15.49	11.84	13.25	-	-	-	2.30	1.36	1.83	-	-	-	-	-	-	-	-	-	-	.24
Raw wool,	1	6.95	7.54	-	-	12.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.63
Wool waste,	11	11.77	24.10	10.20	.96	4.56	3.50	.06	1.68	.67	.05	.31	-	-	-	-	.11	.06	.80	-	-	-	8.20
Wool washings (water),	1	-	-	-	-	-	-	-	3.92	-	-	-	-	-	-	.49	.28	-	-	-	-	-	-
Wool washings (acid),	1	-	-	-	-	-	-	-	4.20	-	-	-	-	-	-	.40	.61	.20	-	-	-	-	-
Wool washings (alkaline),	1	92.03	3.28	-	-	.09	-	-	1.09	-	-	-	-	-	-	.92	.04	-	-	-	-	-	.22
Morocco factory waste,	1	22.72	-	-	-	1.16	-	-	.36	-	-	2.56	-	-	-	-	19.60	-	-	1.24	-	-	24.17
Meat scrap,	2	24.79	-	-	-	6.33	-	-	-	-	-	5.79	-	-	-	-	-	-	-	-	-	-	-
Meat mass,	5	12.09	13.60	11.50	9.69	10.44	-	-	-	3.58	.56	2.07	-	-	-	-	-	-	-	-	-	-	.58
Bone soup,	1	82.92	7.07	-	-	1.14	-	-	-	-	-	1.26	-	-	-	-	-	-	-	-	-	-	-
Dried soup from meat and bone,	1	14.80	8.40	-	-	9.97	-	-	-	-	-	.53	-	-	-	-	-	-	-	-	-	-	.64
Dried soup from rendering cattle feet,	1	10.80	7.50	-	-	14.47	-	-	-	-	-	.46	-	-	-	-	-	-	-	-	-	-	.26
Dried soup from horse rendering,	1	92.14	-	-	-	1.12	-	-	-	-	-	.14	-	-	-	-	-	-	-	-	-	-	-
Soap-grease refuse,	2	29.25	51.39	4.20	2.21	3.21	-	-	-	15.37	11.04	13.21	-	-	-	-	-	-	-	-	-	-	1.29
Bones,	164	6.87	53.03	4.70	1.57	3.91	-	-	-	32.52	15.16	22.37	.38	8.22	13.74	-	-	-	-	-	-	-	1.08

Meat and bone,	2	5.26	-	-	-	4.57	-	-	-	-	-	20.21	.26	7.03	13.05	-	-	-	-	-	-	-	1.22
Tankage,	11	9.57	-	9.16	4.29	6.83	-	-	-	15.86	4.03	11.49	-	4.06	7.46	-	-	-	-	-	-	-	-
Fish with less than twenty per cent. water,	71	12.31	21.50	11.40	5.97	7.56	-	-	-	15.91	5.50	8.48	.55	2.64	5.06	-	-	-	-	-	-	-	2.01
Fish with between twenty and forty per cent. water.	10	30.19	20.59	7.41	4.22	5.97	-	-	-	8.32	4.68	7.09	.74	2.69	3.64	-	-	-	-	-	-	-	1.68
Fish with more than forty per cent. water,	10	45.46	15.50	7.60	2.43	4.97	-	-	-	8.56	2.94	5.08	1.17	1.33	2.58	-	-	-	-	-	-	-	1.35
Whale meat, raw,	1	44.50	1.04	-	-	4.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobster shells,	1	7.27	-	-	-	4.50	-	-	-	-	-	3.52	-	-	-	-	22.24	1.30	-	-	-	-	.27
Castor-bean pomace,	6	9.68	5.70	5.72	5.22	5.51	3.40	.64	1.57	2.26	1.57	2.18	-	-	-	-	.87	.29	-	-	-	-	1.75
Cotton-seed meal,	33	6.78	5.78	7.70	4.02	6.77	2.38	.48	1.77	3.36	.73	1.65	-	-	-	-	-	-	-	-	-	-	.28
Rotten brewers' grain,	1	78.77	-	-	-	.72	-		.04	-	-	.43		-	-	-	.26	.15	-	-	-	-	.59
Mill sweepings,	1	9.49	-	-	-	3.76	-	-	.66	-	-	1.18	-	-	-	-	-	-	-	-	-	-	5.01
Tobacco leaf,	1	13.05	21.01	-	-	2.75	-	-	7.24	-	-	.43	-	-	-	-	4.17	2.17	.32	-	-	-	4.17
Tobacco stems,	7	10.61	14.07	2.91	.90	2.30	10.60	3.76	7.03	2.09	.44	.62	-	-	-	.34	3.89	1.23	-	-	-	-	.82
Cotton waste, wet,	1	34.69	-	-	-	1.30	-	-	.80	-	-	1.54	-	-	-	-	2.45	1.13	-	-	-	-	41.33
Cotton waste, dry,	4	5.87	60.60	9.33	.96	1.77	1.76	.66	1.42	1.80	.26	.45	-	-	-	-	-	-	-	-	-	-	32.59
Refuse from calico works,	1	4.07	-	-	-	4.28	-	-	-	-	-	11.95	-	-	-	-	-	-	-	-	-	-	-
Cotton dust,	1	34.46	50.93	-	-	.50	-	-	.19	-	-	.21	-	-	-	-	.90	.90	-	-	-	-	47.46
Glucose refuse,	1	8.10	-	-	-	2.62	-	-	.15	-	-	.29	-	-	-	-	.18	.02	-	-	-	-	.07
Waste from lactate factory,	1	34.11	-	-	-	.68	-	-	-	-	-	.67	-	-	-	-	22.59	-	-	-	-	-	6.92
Hop refuse,	1	8.98	-	-	-	.98	-	-	.11	-	-	.20	-	-	-	-	.27	.10	-	-	-	-	.63
Banana skins,	1	13.99	-	-	-	.24	-	-	5.46	-	-	1.80	-	-	-	-	-	-	-	-	-	-	-
Tankage and blood,	1	14.43	-	-	-	5.88	-	-	-	-	-	6.84	5.44	1.08	.32	-	-	-	-	-	-	-	-

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
III. Refuse Substances — Concluded.																							
Sumac waste,	1	63.06	6.80	-	-	1.19	-	-	3.25	-	-	-	-	-	-	-	1.14	3.25	-	-	-	-	2.25
Eel-grass,	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	-	-	-	1.63	2.13	.11	-	-	-	-	1.06
Pine-barren grass,	1	8.48	2.40	-	-	.16	-	-	.07	-	-	.18	-	-	-	-	-	-	-	-	-	-	1.67
Pine needles,	1	9.48	3.42	-	-	.46	-	-	.03	-	-	.12	-	-	-	-	-	-	-	-	-	-	1.22
Rockweed, green,	1	68.50	23.70	-	-	.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rockweed, dry,	1	10.68	35.75	-	-	1.45	-	-	4.89	-	-	2.75	-	-	-	7.90	7.66	.21	-	-	-	-	10.40
Jute waste,	1	13.10	-	-	-	1.50	-	-	.08	-	-	.72	-	-	-	-	-	-	-	-	-	-	-
Hair waste,	1	72.81	-	-	-	1.39	-	-	.32	-	-	.61	-	-	-	-	-	-	-	-	-	-	-
Starch waste from rubber factory,	1	10.01	.23	-	-	.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sludge from sewage precipitating tanks,	1	88.49	9.50	-	-	.05	-	-	.05	-	-	.10	-	-	-	-	1.58	.39	6.22	-	-	-	.93
Sludge,	1	6.28	-	-	-	.68	-	-	-	-	-	1.36	-	-	-	-	8.66	-	17.68	-	-	-	38.03
Residue from water filter,	1	94.22	-	-	-	.12	-	-	-	-	-	.05	-	-	-	-	-	-	-	-	-	-	-
Blue-green algæ (*Lyngbia majuscula*), dry,	1	16.26	-	-	-	4.25	-	-	.79	-	-	.19	-	-	-	3.53	2.06	1.18	-	-	-	-	5.53
Mussel mud, wet,	1	60.01	27.29	-	-	.21	-	-	6.17	-	-	.10	-	-	-	.70	.93	.14	3.48	-	-	-	-
Mussel mud, dry,	1	2.24	72.02	-	-	.72	-	-	-	-	-	.35	-	-	-	-	23.39	-	8.26	-	-	-	37.60
Madder,	2	11.93	-	-	-	.91	-	-	2.40	-	-	.35	-	-	-	-	3.93	.51	-	-	-	-	4.67

Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	-	-	-	-	-	-	.94	.91	.37	4.13	-	-	-	34.88
Fresh-water mud,	1	40.37	-	-	-	1.37	-	-	.22	-	-	.26	-	-	-	-	1.27	.29	1.80	-	-	-	18.26
Muck,	22	59.72	13.75	2.54	.26	.86	-	-	-	.17	.08	.13	-	-	-	-	-	-	-	-	-	-	11.35
Peat, wet,	11	61.36	7.66	1.40	.41	.85	-	-	.18	-	-	.09	-	-	-	-	.55	.72	2.14	-	-	-	2.14
Peat, dry,	2	14.67	17.26	-	-	1.89	-	-	.06	-	-	.03	-	-	-	-	-	-	-	-	-	-	10.14
Turf,	2	19.29	6.36	1.97	1.91	1.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soot,	7	4.29	77.10	1.05	.09	.41	1.83	.21	.63	2.10	.19	1.13	-	-	-	-	2.99	1.19	6.38	-	-	-	66.06
IV. Animal Excrement, etc.																							
Barn-yard manure,	76	67.01	-	1.36	.21	.52	1.40	.13	.56	.75	.10	.39	-	-	-	-	.30	.19	-	-	-	-	8.09
Horse manure,	1	11.24	-	-	-	.74	-	-	2.82	-	-	1.46	-	-	-	-	-	-	-	-	-	-	12.60
Sheep manure,	2	50.26	-	-	-	1.15	-	-	.64	-	-	.66	-	-	-	-	-	-	-	-	-	-	12.91
Drainage from a manure heap,	1	93.20	3.66	-	-	.98	-	-	.88	-	-	.24	-	-	-	-	-	-	-	-	-	-	-
Poudrette, dry,	1	5.25	35.45	-	-	3.58	-	-	.49	-	-	5.74	-	-	-	-	-	-	-	-	-	-	4.65
Goose manure,	1	48.92	-	-	-	.21	-	-	.81	-	-	.95	-	-	-	-	-	-	-	-	-	-	-
Hen manure, fresh,	2	52.35	24.75	1.20	.79	.99	.32	.18	.25	1.00	.47	.74	-	-	-	-	1.19	.89	-	1.24	-	-	23.50
Hen-house refuse,	1	3.43	-	-	-	.98	-	-	.60	-	-	1.28	-	-	-	-	-	-	-	-	-	-	-

Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds.

	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
I. Chemicals, Refuse, Salts, Ashes, etc.													
Muriate of potash,	36.	-	-	1020.	-	134.	-	11.	-	-	-	976.	14.
Sulphate of potash (high grade),	42.	-	-	1020.	-	-	-	-	-	866.	-	-	15.
Sulphate of potash-magnesia,	97.	-	-	496.	-	125.	51.	-	-	885.	-	52.	28.
Carbonate of potash,	538.	-	-	370.	-	-	-	390.	-	-	-*	-	8.
Phosphate of potash,	75.	-	-	651.	750.	-	-	-	-	269.	-	-	18.
Kainite,	64.	-	-	271.	-	379.	23.	196.	-	405.	-	665.	43.
Carnallite,	-	-	-	274.	-	153.	-	264.	-	11.	-	831.	-
Krugite,	96.	-	-	168.	-	105.	249.	176.	-	639.	-	133.	299.
Sulphate of magnesia (kieserite),	454.	-	-	-	-	-	56.	346.	-	722.	-	-	115.
Nitrate of potash,	26.	-	254.	905.	-	-	-	-	-	-	-	-	-
Nitrate of soda,	28.	-	300.	-	-	710.	-	-	-	-	-	10.	10.
Sulphate of ammonia,	212.	-	441.	-	-	-	-	-	-	1200.	-	-	-
Phosphate of ammonia,	120.	-	207.	-	877.	-	-	-	-	249.	-	-	16.
Sulphate of soda,	28.	-	-	-	-	-	-	-	-	1189.	-	-	-
Saltpetre waste,	51.	-	44.	273.2	-	740.8	15.	38.	-	37.	-	925.	-

Nitre salt-cake,	121.	-	56.	17.	-	591.	-	-	-	955.	-	-	78.
Wood ashes,	213.	-	-	107.	30.	-	712.	66.	19.	-	-	-	284.
Cotton-seed-hull ashes,	164.	-	-	455.	163.	-	186.	209.	35.	-	-	-	269.
Ashes of spent tan-bark,	97.	-	-	36.	37.	-	622.	68.	36.	-	-	-	504.
Corn-cob ashes,	24.	-	-	142.	47.	-	234.	-	26.	-	-	-	1042.
Railroad-tie ashes,	94.	-	-	18.	11.	-	50.	-	-	-	-	-	1604.
Peat ashes,	93.	-	-	9.	2.	-	46.	33.	123.	-	-	-	903.
Logwood ashes,	30.	-	-	2.	56.	-	78.	-	-	-	-	-	194.
Hard-pine wood ashes,	15.	-	-	203.	45.	-	499.	-	-	-	-	-	598.
Mill ashes,	11.	-	-	32.	9.	-	699.	27.	-	-	-	-	727.
Ashes from cremation of swill,	98.	-	-	93.	293.	-	672.	37.	.93	-	-	-	395.
Ashes from blue works,	243.	1276.	-	180.	-	-	-	-	-	-	-	-	246.
Seaweed ashes,	29.	-	-	18.	6.	175.	121.	87.	-	60.	-	132.	1273.
Gypse,	33.	-	-	-	-	-	1017.	-	-	-	-	-	57.
Nova Scotia plaster (gypsum),	173.	-	-	-	-	-	657.	15.	-	902.	-	-	69.
Onondaga plaster (New York gypsum),	265.	-	-	-	-	-	606.	93.	-	650.	164.	-	187.
Lime (burnt),	-	-	-	-	-	-	1973.	-	-	-	-	-	27.
Waste lime,	16.	-	-	-	-	-	1482.	-	-	-	-	-	8.
Gas-house lime,	446.	-	-	-	-	-	873.	166.	-	415.	-	-	121.
Lime waste from sugar factory,	726.	-	-	4.	45.	-	550.	-	-	-	-	-	6.
Lime-kiln ashes,	290.	-	-	26.	22.	-	851.	52.	-	-	355.	-	154.
Bituminous coal ashes,	144.	-	-	12.	9.	-	-	-	-	-	-	-	1370.

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* Not determined.

Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Continued.

	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
I. Chemicals, Refuse, Salts, Ashes, etc. — Concluded.													
Marls (Massachusetts),	274.	-	-	5.	21.	-	810.	13.	14.	-	571.	-	69.
Marls (Virginia),	320.	-	-	10.	2.	-	145.	4.	-	13.	145.	-	1285.
Green sand marls (Virginia),	25.	-	-	23.	187.	-	516.	-	103.	-	-	-	826.
Olive earth (Virginia),	39.	-	-	5.	275.	-	383.	-	120.	-	-	-	1011.
Ammoniated marl,	66.	-	32.	-	208.	-	-	-	-	-	-	-	-
Marl (North Carolina),	30.	-	-	1.	11.	-	439.	12.	-	-	-	-	1004.
II. Guanos, Phosphates, etc.													
Peruvian guano,	296.	752.	157.	52.	305.	-	-	-	-	-	-	-	132.
Bat guano from Texas,	802.	365.	129.	26.	75.	-	-	-	-	-	-	-	40.
Bat guano from Florida,	313.	-	195.	25.	67.	-	-	-	-	-	-	-	387.
Rat guano from Florida,	206.	-	66.	137.	46.	-	-	-	-	-	-	-	23.
Cuban guano,	485.	-	33.	-	267.	-	-	-	-	-	-	-	63.
Caribbean guano (orchilla),	146.	-	-	-	535.	-	799.	66.	-	54.	-	-	25.
Mona Island guano,	266.	-	15.	-	438.	-	750.	-	-	-	-	-	49.

South Carolina rock phosphate,	29.	-	-	-	549.	-	837.	61.	96.	-	-	-	181.
South Carolina floats,	17.	-	-	-	468.	-	-	-	-	-	-	-	403.
Florida rock phosphate,	42.	-	-	-	523.	-	608.	-	151.	-	-	-	556.
Soft Florida phosphate,	97.	-	-	-	375.	-	274.	-	136.	-	-	-	418.
Navassa phosphate,	152.	-	-	-	685.	-	749.	-	205.	-	-	-	54.
Brockville phosphate,	50.	-	-	-	704.	-	-	-	-	-	-	-	129.
Phosphatic slag,	29.	-	-	-	470.	-	973.	68.	202.	-	-	-	188.
Odorless phosphate,	60.	-	-	8.	391.	-	1028.	-	-	-	50.	-	183.
Dissolved bone-black,	206.	950.	-	-	320.	-	-	-	-	-	-	-	80.
Bone-black,	92.	-	-	-	565.	-	-	-	-	-	-	-	73.
Double superphosphate,	115.	-	-	-	956.	-	320.	-	-	24.	-	-	12.
South American bone ash,	140.	-	-	-	718.	-	898.	-	-	-	-	-	90.
Acid phosphate,	285.	1399.	-	-	293.	-	-	-	-	-	-	-	216.
III. Refuse Substances.													
Dried blood,	239.	127.	210.	-	40.	-	-	-	-	-	-	-	-
Ammonite,	118.	-	227.	-	69.	-	-	-	-	-	-	-	28.
Oleomargarine refuse,	171.	288.	242.	-	18.	-	-	-	-	-	-	-	19.
Felt refuse,	585.	671.	105.	-	-	-	-	-	-	-	-	-	-
Sponge refuse,	145.	-	49.	-	64.	-	79.	25.	-	-	-	-	781.
Blood and bone,	167.	-	135.	-	220.	-	-	-	-	-	-	-	-
Horn shavings,	99.	-	306.	-	8.	-	-	-	-	-	-	-	-
Ivory dust,	230.	1053.	133.	-	491.	-	-	-	-	-	-	-	-

Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Continued.

	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
III. Refuse Substances — Continued.													
Horn and hoof waste,	203.	153.	265.	-	37.	-	-	-	-	-	-	-	5.
Raw wool,	139.	151.	258.	-	-	-	-	-	-	-	-	-	72.
Wool waste,	235.	582.	91.	34.	6.	-	2.	1.	16.	-	-	-	164.
Wool washings (water),	-	-	-	78.	-	10.	6.	-	-	-	-	-	-
Wool washings (acid),	-	-	-	84.	-	8.	12.	4.	-	-	-	-	-
Wool washings (alkaline),	1841.	66.	2.	22.	-	18.	1.	-	-	-	-	-	4.
Morocco factory waste,	454.	-	23.	7.	51.	-	392.	-	-	25.	-	-	483.
Meat scrap,	496.	-	127.	-	116.	-	-	-	-	-	-	-	-
Meat mass,	242.	272.	209.	-	41.	-	-	-	-	-	-	-	12.
Bone soup,	1658.	141.	23.	-	25.	-	-	-	-	-	-	-	-
Dried soup from meat and bone,	296.	168.	199.	-	11.	-	-	-	-	-	-	-	13.
Dried soup from rendering cattle feet,	216.	150.	289.	-	9.	-	-	-	-	-	-	-	5.
Dried soup from horse rendering,	1843.	-	22.	-	3.	-	-	-	-	-	-	-	-
Soap-grease refuse,	585.	1028.	64.	-	264.	-	-	-	-	-	-	-	26.
Bones,	137.	1061.	78.	-	447.	-	-	-	-	-	-	-	22.

Meat and bone,	105.	-	91.	-	404.	-	-	-	-	-	-	-	24.
Tankage,	191.	-	138.	-	230.	-	-	-	-	-	-	-	-
Fish with less than twenty per cent. water,	246.	430.	151.	-	170.	-	-	-	-	-	-	-	40.
Fish with between twenty and forty per cent. water,	604.	412.	119.	-	142.	-	-	-	-	-	-	-	34.
Fish with more than forty per cent. water,	909.	310.	99.	-	102.	-	-	-	-	-	-	-	27.
Whale meat, raw,	890.	21.	96.	-	-	-	-	-	-	-	-	-	-
Lobster shells,	145.	-	90.	-	70.	-	445.	26.	-	-	-	-	5.
Castor-bean pomace,	194.	114.	110.	31.	44.	-	17.	6.	-	-	-	-	35.
Cotton-seed meal,	136.	116.	135.	35.	33.	-	-	-	-	-	-	-	6.
Rotten brewers' grain,	1575.	-	15.	1.	17.	-	5.	3.	-	-	-	-	12.
Mill sweepings,	190.	-	75.	13.	24.	-	-	-	-	-	-	-	100.
Tobacco leaf,	261.	420.	55.	145.	9.	-	83.	43	6.	-	-	-	83.
Tobacco stems,	212.	281.	46.	141.	12.	7.	78.	25.	-	-	-	-	16.
Cotton waste, wet,	694.	-	26.	16.	31.	-	49.	23.	-	-	-	-	827.
Cotton waste, dry,	117.	1212.	35.	28.	9.	-	-	-	-	-	-	-	652.
Refuse from calico works,	81.	-	86.	-	239.	-	-	-	-	-	-	-	-
Cotton dust,	689.	1019.	10.	4.	4.	-	18.	18.	-	-	-	-	949.
Glucose refuse,	162.	-	52.	3.	6.	-	4.	.4	-	-	-	-	1.
Waste from lactate factory,	682.	-	14.	-	13.	-	452.	-	-	-	-	-	138.
Hop refuse,	180.	-	20.	2.	4.	-	5.	2.	-	-	-	-	13.
Banana skins,	280.	-	5.	109.	36.	-	-	-	-	-	-	-	-
Tankage and blood,	289.	-	118.	-	137.	-	-	-	-	-	-	-	-

Average Per Cents. of Different Ingredients found in the Preceding Compilation of Analyses, calculated to Pounds per Ton of 2,000 Pounds — Concluded.

	Moisture.	Ash.	Nitrogen.	Potash.	Total Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
III. Refuse Substances — Concluded.													
Sumac waste,	1261.	136.	24.	65.	-	-	23.	65.	-	-	-	-	45.
Eel grass,	708.	312.	17.	18.	6.	33.	43.	2.	-	-	-	-	21.
Pine-barren grass,	170.	48.	3.	1.	4.	-	-	-	-	-	-	-	33.
Pine needles,	200.	68.	9.	1.	2.	-	-	-	-	-	-	-	24.
Rockweed, green,	1370.	474.	12.	-	-	-	-	-	-	-	-	-	-
Rockweed, dry,	214.	715.	29.	98.	55.	158.	153.	4.	-	-	-	-	208.
Jute waste,	262.	-	3.	2.	14.	-	-	-	-	-	-	-	-
Hair waste,	1456.	-	28.	6.	12.	-	-	-	-	-	-	-	-
Starch waste from rubber factory,	200.	5.	4.	-	-	-	-	-	-	-	-	-	-
Sludge from sewage precipitating tanks,	1770.	190.	1.	1.	2.	-	32.	8.	124.	-	-	-	19.
Sludge,	126.	-	14.	-	27.	-	173.	-	354.	-	-	-	761.
Residue from water filter,	1884.	-	2.	-	1.	-	-	-	-	-	-	-	-
Blue-green algæ (*Lyngbia majuscula*), dry,	325.	-	85.	16.	4.	71.	41.	24.	-	-	-	-	111.
Mussel mud, wet,	1200.	546.	4.	123.	2.	14.	19.	3.	70.	-	-	-	-
Mussel mud, dry,	45.	1440.	14.	-	7.	-	1468.	165.	-	-	-	-	752.

Madder,	239.	-	18.	48.	7.	-	79.	10.	-	-	-	-	93.
Salt mud,	1567.	824.	8.	7.	-	19.	18.	7.	83.	-	-	-	798.
Fresh-water mud,	807.	-	27.	4.	5.	-	25.	6.	36.	-	-	-	365.
Muck,	1194.	275.	18.	-	3.	-	-	-	-	-	-	-	227.
Peat, wet,	1227.	153.	17.	4.	2.	-	11.	14.	43.	-	-	-	43.
Peat, dry,	293.	345.	38.	1.	1.	-	-	-	-	-	-	-	203.
Turf,	386.	127.	39.	-	-	-	-	-	-	-	-	-	-
Soot,	86.	1542.	8.	13.	23.	-	60.	24.	128.	-	-	-	1321.
IV. Animal Excrement, etc.													
Barn-yard manure,	1340.	-	10.	11.	8.	-	6.	4.	-	-	-	-	162.
Horse manure,	225.	-	15.	56.	29.	-	-	-	-	-	-	-	252.
Sheep manure,	1205.	-	23.	33.	13.	-	-	-	-	-	-	-	258.
Drainage from manure heap,	1864.	73.	20.	18.	5.	-	-	-	-	-	-	-	-
Poudrette, dry,	105.	709.	72.	10.	115.	-	-	-	-	-	-	-	93.
Goose manure,	978.	-	4.	16.	19.	-	-	-	-	-	-	-	-
Hen manure, fresh,	1047.	49.	20.	5.	15.	-	24.	18.	-	25.	-	-	470.
Hen-house refuse,	69.	-	20.	12.	26.	-	-	-	-	-	-	-	-

4. Compilation of Analyses of Fruits, Garden Crops and Insecticides.

COMPILED BY H. D. HASKINS.

1. — Analyses of fruits.
2. — Analyses of garden crops.
3. — Relative proportions of phosphoric acid, potassium oxide and nitrogen in fruits and garden crops.
4. — Analyses of insecticides.

A computation of the results of a chemical analysis of twenty prominent garden crops shows the following average relative proportion of the three essential ingredients of plant food : —

	Parts.
Nitrogen,	2.2
Potassium oxide,	2.0
Phosphoric acid,	1.0

One thousand pounds of green garden vegetables contain, on the above-stated basis of relative proportion of essential constituents of plant food : —

	Pounds.
Nitrogen,	4.1
Potassium oxide,	3.9
Phosphoric acid,	1.9

The weight and particular stage of growth of the vegetables when harvested control, under otherwise corresponding conditions, the actual consumption of each of these articles of plant food. Our information regarding these points is still too fragmentary to enable a more detailed statement here beyond relative proportions. It must suffice for the present to call attention to the fact that a liberal manuring within reasonable limit pays, as a rule, better than a scanty one. — (C. A. Goessmann.)

1. Analyses of Fruits.

Fertilizing Constituents of Fruits.

[Average amounts in 1,000 parts of fresh or air-dry substance.]

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Ericaceæ: —										
*Cranberries,	996	–	1.8	.9	.1	.3	.1	.3	–	–
*Cranberries,	894	.8	–	1.0	–	.2	.1	.3	–	–
Rosaceæ: —										
Apples,	831	.6	2.2	.8	.6	.1	.2	.3	.1	–
*Apples,	799	1.3	4.1	1.9	.3	.3	.3	.1	–	–
*Peaches,	884	–	3.4	2.5	–	.1	.2	.5	–	–
Pears,	831	.6	3.3	1.8	.3	.3	.2	.5	.2	–
Strawberries,	902	–	3.3	.7	.9	.5	–	.5	.1	.1
*Strawberries,	–	–	5.2	2.6	.2	.7	.4	1.0	–	–
*Strawberry vines,	–	–	33.4	3.5	4.5	12.2	1.3	4.8	–	–
Cherries,	825	–	3.9	2.0	.1	.3	.2	.6	.2	.1
Plums,	838	–	2.9	1.7	–	.3	.2	.4	.1	–
Saxifragaceæ: —										
*Currants, white,	–	–	5.9	3.1	.2	1.0	.3	1.1	–	–
*Currants, red,	871	–	4.1	1.9	.2	.8	.3	.9	–	–
Gooseberries,	903	–	3.3	1.3	.3	.4	.2	.7	–	–
Vitaceæ: —										
Grapes,	830	1.7	8.8	5.0	.1	1.0	.4	1.4	.5	.1
Grape seed,	110	19.0	22.7	6.9	.5	5.6	1.4	7.0	.8	.1

2. *Analyses of Garden Crops.*

Fertilizing Constituents of Garden Crops.

[Average amounts in 1,000 parts of fresh or air-dry substance.]

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Chenopodiaceæ:—										
Mangolds,	880	1.8	9.1	4.8	1.5	.3	.4	.8	.3	.9
*Mangolds,	873	1.9	12.2	3.8	1.3	.6	.4	.9	–	–
Mangold leaves,	905	3.0	14.6	4.5	2.8	1.6	1.4	1.0	.8	2.3
Sugar beets,	805	1.6	7.1	3.8	.6	.4	.6	.9	.3	.3
*Sugar beets,	869	2.2	10.4	4.8	.8	.6	.4	1.0	.1	–
Sugar-beet tops,	840	2.0	9.6	2.8	2.3	.9	1.1	1.2	.2	.3
Sugar-beet leaves,	897	3.0	15.3	4.0	2.0	3.1	1.7	.7	.8	1.3
Sugar-beet seed,	146	–	45.3	11.1	4.2	10.2	7.3	7.5	2.0	1.9
*Red beets,	877	2.4	11.3	4.4	.9	.5	.3	.9	–	–
Spinach,	903	2.4	16.0	2.7	5.7	1.9	1.0	1.6	1.1	1.0
*Spinach,	922	3.4	9.6	9.6	2.1	.6	.5	.5	–	–
Compositeæ:—										
Lettuce, common,	940	–	8.1	3.7	.8	.5	.2	.7	.3	.4
Head lettuce,	943	2.2	10.3	3.9	.8	1.5	.6	1.0	.4	.8
*Head lettuce,	970	1.2	–	2.3	.2	.3	.1	.3	–	–
Roman lettuce,	925	2.0	9.8	2.5	3.5	1.2	.4	1.1	.4	.4
Artichoke,	811	–	10.1	2.4	.7	1.0	.4	3.9	.5	.2
*Artichoke, Jerusalem,	775	4.6	–	4.8	–	–	–	1.7	–	–
Convolvulaceæ:—										
Sweet potato,	758	2.4	7.4	3.7	.5	.7	.3	.8	.4	.9
Cruciferæ:—										
White turnips,	920	1.8	6.4	2.9	.6	.7	.2	.8	.7	.3
*White turnips,	895	1.8	10.1	3.9	.8	.9	.3	1.0	1.0	–
White turnip leaves,	898	3.0	11.9	2.8	1.1	3.9	.5	.9	1.1	1.2
*Ruta-bagas,	891	1.9	10.6	4.9	.7	.9	.3	1.2	–	–
Savoy cabbage,	871	5.3	14.0	3.9	1.4	3.0	.5	2.1	1.2	1.1
White cabbage,	900	3.0	9.6	4.3	.8	1.2	.4	1.1	1.3	.5
*White cabbage,	984	2.3	–	3.4	.3	.2	.1	.2	–	–
Cabbage leaves,	890	2.4	15.6	5.8	1.5	2.8	.6	1.4	2.4	1.3
Cauliflower,	904	4.0	8.0	3.6	.5	.5	.3	1.6	1.0	.3
Horse-radish,	767	4.3	19.7	7.7	.4	2.0	.4	2.0	4.9	.3

Fertilizing Constituents of Garden Crops — Continued.

[Average amounts in 1,000 parts of fresh or air-dry substance.]

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Cruciferæ — Concluded.										
Radishes,	933	1.9	4.9	1.6	1.0	.7	.2	4.5	.3	.5
Kohlrabi,	850	4.8	12.3	4.3	.8	.4	.8	2.7	1.1	.6
Cucurbitaceæ: —										
Cucumbers,	956	1.6	5.8	2.4	.6	.4	.2	1.2	.4	.4
Pumpkins,	900	1.1	4.4	.9	.9	.3	.2	.7	.3	.4
Gramineæ: —										
Corn, whole plant, green,	829	1.9	10.4	3.7	.5	1.4	1.1	1.0	.3	.5
*Corn, whole plant, green,	786	4.1	-	3.8	.5	1.5	.9	1.5	-	-
Corn kernels,	144	16.0	12.4	3.7	.1	.3	1.9	5.7	.1	.2
*Corn kernels,	100	18.2	-	4.0	.3	.3	2.1	7.0	-	-
*Corn, whole ears,	90	14.1	-	4.7	.6	.2	1.8	5.7	-	-
*Corn stover,	282	11.2	37.4	13.2	7.9	5.2	2.6	3.0	-	-
Leguminosæ: —										
Hay of peas, cut green,	167	22.9	62.4	23.2	2.3	15.6	6.3	6.8	5.1	2.0
*Cow-pea (*Dolichos*), green,	788	2.9	-	3.1	.6	3.0	1.0	1.0	-	-
*Small pea (*Lathyrus sylvestris*), dry.	90	38.5	-	25.7	4.7	17.9	5.0	9.0	-	-
Peas (seed),	143	35.8	23.4	10.1	.2	1.1	1.9	8.4	.8	.4
Pea straw,	160	10.4	43.1	9.9	1.8	15.9	3.5	3.5	2.7	2.3
Garden beans (seed),	150	39.0	27.4	12.1	.4	1.5	2.1	9.7	1.1	.3
Bean straw,	166	-	40.2	12.8	3.2	11.1	2.5	3.9	1.7	3.1
Liliaceæ: —										
Asparagus,	933	3.2	5.0	1.2	.9	.6	.2	.9	.3	.3
Onions,	860	2.7	7.4	2.5	.2	1.6	.3	1.3	.4	.2
*Onions,	892	-	4.9	1.8	.1	.4	.2	.7	-	-
Solanaceæ: —										
Potatoes,	750	3.4	9.5	5.8	.3	.3	.5	1.6	.6	.3
*Potatoes,	798	2.1	9.9	2.9	.1	.1	.2	.7	-	-
Potato tops, nearly ripe,	770	4.9	19.7	4.3	.4	6.4	3.3	1.6	1.3	1.1
Potato tops, unripe,	825	6.3	16.5	4.4	.3	5.1	2.4	1.2	.8	.9
*Tomatoes,	940	1.7	-	3.6	-	.3	.2	.4	-	-
Tobacco leaves,	180	34.8	140.7	40.7	4.5	50.7	10.4	6.6	8.5	9.4
Tobacco stalks,	180	24.6	64.7	28.2	6.6	12.4	.5	9.2	2.2	2.4
*Tobacco stems,	106	22.9	140.7	64.6	3.4	38.9	12.3	6.0	-	-

Fertilizing Constituents of Garden Crops — Concluded.

[Average amounts in 1,000 parts of fresh or air-dry substance.]

	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Phosphoric Acid.	Sulphuric Acid.	Chlorine.
Umbelliferæ : —										
Carrots,	850	2.2	8.2	3.0	1.7	.9	.4	1.1	.5	.4
*Carrots,	898	1.5	9.2	5.1	.6	.7	.2	.9	-	-
Carrot tops,	822	5.1	23.9	2.9	4.7	7.9	.8	1.0	1.8	2.4
Carrot tops, dry,	98	31.3	125.2	48.8	40.3	20.9	6.7	6.1	-	-
Parsnips,	793	5.4	10.0	.4	.2	1.1	.6	1.9	.5	.4
*Parsnips,	803	2.2	-	6.2	.1	.9	.5	1.9	-	-
Celery,	841	2.4	17.6	7.6	-	2.3	1.0	2.2	1.0	2.8

Most of the foregoing analyses were compiled from the tables of E. Wolff. Those marked * are from analyses made at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

3. *Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Fruits.*

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Ericaceæ : —			
*Cranberries,	1	3.0	–
*Cranberries,	1	3.4	2.6
Rosaceæ : —			
Apples,	1	2.7	2.0
*Apples,	1	1.9	1.3
*Peaches,	1	1.3	–
Pears,	1	3.6	1.2
Strawberries,	1	1.4	–
*Strawberries,	1	2.6	–
*Strawberry vines,	1	.7	–
Cherries,	1	3.3	–
Plums,	1	4.3	–
Saxifragaceæ : —			
*Currants, white,	1	2.8	–
*Currants, red,	1	2.1	–
Gooseberries,	1	1.9	–
Vitaceæ : —			
Grapes,	1	3.6	1.2
Grape seed,	1	1.0	2.7

Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Garden Crops.

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Chenopodiaceæ: —			
Mangolds,	1	6.0	2.3
*Mangolds,	1	4.2	2.1
Mangold leaves,	1	4.5	3.0
Sugar beets,	1	4.2	1.8
*Sugar beets,	1	4.8	2.2
Sugar-beet tops,	1	2.3	1.7
Sugar-beet leaves,	1	5.7	4.3
Sugar-beet seed,	1	1.5	–
*Red beets,	1	4.1	3.3
Spinach,	1	1.7	3.1
*Spinach,	1	19.2	6.8
Compositeæ: —			
Lettuce,	1	5.3	–
*Lettuce,	1	7.6	4.0
Head lettuce,	1	3.9	2.2
Roman lettuce,	1	2.3	1.8
*Jerusalem artichoke,	1	2.8	2.7
Convolvulaceæ: —			
Sweet potato,	1	4.6	3.0
Cruciferæ: —			
White turnips,	1	3.6	2.3
*White turnips,	1	3.9	1.8
White turnip leaves,	1	3.1	3.3
*Ruta-bagas,	1	4.1	1.6
Savoy cabbage,	1	1.9	2.5
White cabbage,	1	4.1	1.7
*White cabbage,	1	11.0	7.6
Cauliflower.	1	2.3	2.5
Horse-radish,	1	3.9	2.2
Radishes,	1	3.2	3.8
Kohlrabi,	1	1.6	1.8
Cucurbitaceæ: —			
Cucumbers,	1	2.0	1.3
Pumpkins,	1	.6	.7
Gramineæ: —			
Corn, whole plant, green,	1	3.7	1.9
*Corn, whole plant, green,	1	2.2	2.8
Corn kernels,	1	.6	2.8
*Corn kernels,	1	.6	2.6
*Corn, whole ears,	1	.8	2.5
*Corn stover,	1	4.4	3.7

Relative Proportions of Phosphoric Acid, Potassium Oxide and Nitrogen in Garden Crops — Concluded.

	Phosphoric Acid.	Potassium Oxide.	Nitrogen.
Leguminosæ: —			
Hay of peas, cut green, . .	1	3.4	3.4
*Cow-pea (*Dolichos*), . . .	1	3.1	2.9
*Small pea (*Lathyrus sylvestris*),	1	3.4	4.2
Peas (seed), ...	1	1.2	4.3
Pea straw, ...	1	2.8	4.0
Garden beans (seed), . . .	1	1.2	4.0
Bean straw, ...	1	3.3	–
Liliaceæ: —			
Asparagus, ...	1	1.3	3.6
Onions, ...	1	1.9	2.1
*Onions, ...	1	2.6	–
Solanaceæ: —			
Potatoes, ...	1	3.6	2.1
*Potatoes, ...	1	4.1	3.0
Potato tops, nearly ripe, . .	1	2.7	3.1
Potato tops, unripe, . . .	1	3.7	5.3
*Tomatoes, ...	1	8.7	4.5
Tobacco leaves, ...	1	6.2	5.3
Tobacco stalks, ...	1	3.1	2.7
Tobacco stems, ...	1	10.7	3.8
Umbelliferæ: —			
Carrots, ...	1	2.7	2.0
*Carrots, ...	1	5.7	1.7
Carrot tops, ...	1	2.9	5.1
*Carrot tops, dry, ...	1	8.0	5.1
Parsnips, ...	1	3.8	2.8
*Parsnips, ...	1	3.3	1.2
Celery, ...	1	3.5	1.1

4. *Analyses of Insecticides.*

	Moisture.	Arsenious Oxide.	Copper Oxide.	Acetic Acid.	Nicotine.	Mercury.	Sulphur.	Sulphuric Acid.	Chlorine.	Calcium Oxide.	Potassium Oxide.	Ferric and Aluminic Oxides.	Matter Insoluble in Hydrochloric Acid.
Paris green,	1.30	62.55	32.84	3.10	-	-	-	-	-	-	-	-	0.21
Paris green,	1.41	61.40	33.20	3.90	-	-	-	-	-	-	-	-	0.09
Paris green,	1.40	61.15	33.10	3.71	-	-	-	-	-	-	-	-	0.64
Paris green,	1.15	53.91	31.27	8.10	-	-	-	-	-	-	-	-	0.04
Paris green,	1.34	61.25	33.35	3.93	-	-	-	-	-	-	-	-	0.13
Paris green,	1.31	61.21	33.45	3.94	-	-	-	-	-	-	-	-	0.09
Paris green,	1.15	59.92	30.40	-	-	-	-	-	-	-	-	-	0.10
Paris green,	1.27	54.80	30.85	6.50	-	-	-	-	-	-	-	-	0.12
"Sulphatine,"	1.40	-	2.61	-	-	-	48.28	4.73	-	18.60	-	-	1.63
"Death to Rose Bugs,"	2.95	-	1.05	-	-	-	34.53	4.35	-	17.76	-	-	0.49
"Professor De Graff's Carpet Bug Destroyer,"	95.81	-	-	-	-	0.78	-	0.48	0.27	-	0.26	0.90	-
"Oriental Fertilizer and Bug Destroyer,"	87.14	2.38	-	-	-	-	-	.64	3.00	-	3.50	-	-
"Non-poisonous Potato Bug Destroyer,"	-	-	-	-	-	-	-	-	-	68.20	-	1.38	1.50
Tobacco liquor,	37.71	-	-	-	2.12	-	-	-	-	3.07	6.55	0.23	-
Tobacco liquor,	40.89	-	-	-	0.53	-	-	-	-	1.47	16.34	0.01	-
Tobacco liquor,	-	-	-	-	4.55	-	-	-	-	-	-	-	-
Tobacco liquor,	-	-	-	-	4.82	-	-	-	-	-	-	-	-
"Nicotinia,"	10.00	-	-	-	-	-	-	-	-	4.45	9.15	-	2.12
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	2.34
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	38.12
"Peroxide of Silicate,"	1.65	0.57	0.33	-	-	-	-	49.66	-	41.18	-	-	2.31

As a rule, in all preceding analyses the essential constituents are determined and stated; blanks do not imply the absence of the non-essentials.

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